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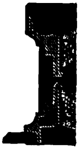

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BY "THE KERNEL."

(LIEUT.-GENERAL H. P. HAWKES, C.B.)

WITH ILLUSTRATIONS BY THE AUTHOR.

ALSO A CHAPTER ON THE RÖNTGEN RAYS

BY DR. HALL-EDWARDS.

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PREFACE.

I TAKE advantage of the issue of another edition of the "Nutshell" to thank Messrs. Waterlow and Sons, of London, for the frontispiece which has been admirably reproduced and printed.

H. P. HAWKES.

OCTOBER, 1898.

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PHOTOGRAPHY IN A NUTSHELL.

CHAPTER I.—APPARATUS.

THE CAMERA.

1. **Cameras** may be roughly divided into "stand cameras" and "hand cameras." The former are most useful to those who mainly employ themselves with landscape work. The latter, whilst indispensable for subjects in rapid movement, are also suited, in skilful hands, for general purposes.

To be thoroughly efficient, the operator should possess a camera of each kind, and in cases where both these are quarter-plate, it will be found very convenient if the same slides fit both cameras.

STAND CAMERAS.

2. For special purposes, cameras of all sizes are both desirable and necessary, but for those who require a camera for landscape and general work, *and have to carry their own apparatus*, there is a limit of weight beyond which it is not possible to go. This limit is generally fixed at the half-plate camera, which takes pictures on plates 6½ × 4¾ inches, and with this size very presentable prints may be made.

3. For those who prefer other sizes, the dimensions of the plates in general use are given.

Lantern size	3¼ × 3¼	Other recognised sizes are ...	5 × 4
Quarter-plate	4¼ × 3¼		7½ × 5
Half-plate	6½ × 4¾		10 × 8
Whole-plate	8½ × 6½		12 × 10

The "cabinet size," so often spoken of, appears to be of no fixed dimensions—cabinet pictures are usually taken on half-plates, and the prints trimmed afterwards as required. The cabinet *mount* usually measures 6⅝ × 4¼in., but the dimensions of different makers vary slightly. The sizes of ordinary *foreign* plates are given in the last chapter.

4. **Details of stand camera.**—A square bellows is generally preferable; those of tapering shape are *sometimes* liable to cut off a portion of the picture when the rising front is used, especially when upright subjects are being taken.

The camera *must* have a "reversing back," so that either horizontal or upright pictures may be taken at will. It should also have a rising front.

A vertical swing back is *necessary;* a side swing motion is also desirable, though not so often used.

A camera can hardly be said to be complete without at least *three* dark slides, which will hold six plates. For work away from home, three additional slides will be found convenient.

5. When exposing, it is often difficult to know whether the slide-shutter has been *fully* pulled out, and if this has not been done, a portion of the picture is cut off. To remedy this, take the dark slide when not in use, draw the slide shutter out, and run a thin line of white or yellow quick-drying paint along the inside of the slide shutter close up to the frame. When drawing the slide to expose, it is known to be fully open when the paint line appears. The paint should be allowed to dry thoroughly before the backs are filled, or the negatives will be marked. A line drawn with a red pencil does almost as well, but must be frequently renewed.

For those absent-minded operators who first take a picture and then forget five minutes afterwards whether the plate has been exposed or not, a safety catch of some sort—for locking the slide-shutter after exposure—is useful.

6. If at any time the *slide-shutter* is found to have become tight in the frame, so that the camera is liable to be moved owing to the force required to withdraw it for exposure, draw the slide-shutter out to its full extent and look along the bearing edges for some signs of friction, touch these *very lightly* with a fine file, and then well rub them with a soft (BB) lead pencil —this will generally be found to effect a remedy—if not, the slide should be sent to the maker for repair. A bit of solid paraffin rubbed along the rebate is also useful.

If a slide should get accidentally wetted, it should not be dried by the fire or in the sun, but opened out, the slide-shutter drawn, and the slide placed in a drawer, leaving only a chink open for the air to circulate. It *may* then possibly be saved.

The slides, when not in use, should be occasionally opened out, and stood on their edges in a dry room, so that they may be thoroughly aired.

7. It is often required to use smaller plates in the ordinary camera. For this purpose it is convenient to have movable inner frames to fit the slides. They should be tested to see that they are in correct register with the focussing screen—see para. 14.

8. **Slide protectors.**—Every dark slide of half-plate size or upwards should have its own *stiff* cardboard case, lined with flannel, and covered outside with book-binders' cloth, and the numbers on the slides which each protector contains should be legibly *painted* on the flaps and sides in figures at least half an inch in height.

When using at the same time plates of different makers or of the same maker but of different rapidities, it is well to paste small slips of white paper on the outside of the slide protectors, and to make on them a note of the plates contained in the slides. It saves much exercising of the memory when about to expose. Some slide-protectors are specially fitted with ivory tablets for this purpose.

9. **Cases for cameras.**—These are made of various materials—some are of millboard, covered with brown waterproof (?) canvas, others of stout leather. If the latter material is selected, it should be japanned to prevent its absorbing damp.

10. **Satchels.**—But those who work much at a distance from home will find a pair of really waterproof satchels far more convenient than the usual bulky case.

One of these satchels should hold the camera, lenses, diaphragms, and caps, focussing glass, level, shutter, view-finder, and exposure notebook. The other should take the dark slides and the focussing cloth—see fig. 1.

The straps should be so arranged that the satchels may either be carried by hand or slung over the shoulders; this is effected by attaching a movable strap of broad 3in. *webbing* to the leather straps already fixed to the satchels. The satchels should also be fitted with spring locks, which add but a trifle to the cost, and secure the contents from meddlesome fingers.

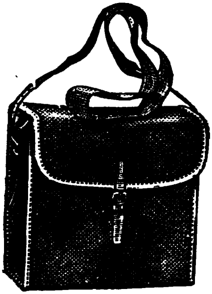
Fig. 1.

A satchel provided only with the ordinary leather strap and buckle for fastening may be effectually secured by enlarging one of the holes of the strap below the one usually buckled, and passing through it a *small* padlock.

A list of the contents of each satchel should be written on a tough luggage label and stitched inside the flap, and the items should be *carefully verified before leaving home.*

11. **Tripod.**—A good *firm* tripod is essential. Avoid, if possible, one with too many joints, which tend to diminish rigidity. A five-foot tripod, with only one joint in each leg, will strap conveniently with rugs and umbrellas when travelling, whilst one of the same length, but with two joints in each leg, will fit into any portmanteau.

The tripod top and screw should not be detachable from the tripod itself, but should be indissolubly fixed to it, so that there may be no chance of their being lost or forgotten. The legs should be so fitted to the tripod top that they *cannot become detached* when the camera on its stand is carried over the shoulder. When metal tripod heads are used, they should be covered with leather or good soft felt.

The screw which attaches the camera to the tripod should have the last few threads next the head filed out; this enables the operator to clamp the camera freely.

12. **Focussing cloth.**—A very light waterproof material is liked by some, but it is liable to become stiff, and is more easily blown about than the close-woven black sateen, which is usually preferred. But whatever material is chosen, the focussing cloth should be *fastened to the front of the camera* by any suitable means. Two round-headed brass screws fixed to the camera frame, with two eyelet holes in the focussing cloth, is as good a plan as any. The cloth will thus cover the bellows and dark back, and do much to prevent fogging.

13. **Focussing screen.**—This should be of very finely ground glass; a spare celluloid focussing screen should always be carried when on tour. Other substitutes for a broken focussing screen will be found in the last chapter.

There are numerous devices for sharpening the image on the focussing screen. A trace of oil or vaseline, or wax dissolved in benzole, first rubbed over the glass and the surplus polished off, have been recommended. For very special work a mark may be made with pencil on the ground side of the screen, and a circle of thin glass, such as is used to cover microscopic objects, cemented with Canada balsam over the pencil mark; but when this is done a compound focussing glass is desirable. Even moistening the focussing glass on the ground side improves definition.

14. It is necessary that the ground glass of the focussing screen and the sensitive plate in the dark slides should be in accurate register. The simplest way to test this is to take a small wooden wedge, such as is sometimes used to prevent windows rattling, and, having placed the focussing screen on the table, with the *ground* surface of the glass uppermost, lay a flat ruler across it, insert the wedge between the glass and the ruler, and mark on it, in pencil, how far it will go. Then put a plate in the slide to be tested, draw the shutter and repeat the operation. If the wedge goes up to the former mark, the slide is correct.

15. The inside of the camera frame and bellows should be *dull* black—this should be occasionally looked to, for any trace of shininess is a fertile source of fogged negatives. Many excellent dead black varnishes are sold for this purpose.

16. Finally, a good camera should be treated with the utmost care. When not in use it should be packed away in its case, kept in a dry room, and dusted occasionally both inside and outside. When using it in cold weather, and bringing it suddenly from a warm house into the cold air, the focussing screen should be opened for a short time to prevent moisture condensing on the lens. The camera should also be occasionally examined to see that there is no leakage of light. The lens being capped, and the ground glass screen turned back, the focussing cloth is thrown over the head, and carefully gathered in round the camera frame. In a minute or two, when the eye has accommodated itself to the darkness, any pinhole in the bellows or elsewhere will be readily detected.

17. *Lenses for stand camera.*—Where only one lens is to be purchased, the most generally useful one for a half-plate camera would be a rectilinear lens of about 8in. or 9in. focus. This would serve for landscapes, groups, instantaneous work, copying, etc.

A full battery of lenses for a half-plate camera should comprise a 5in. or 6in. wide-angled rectilinear lens for interiors or architectural subjects in confined places; a rectilinear lens of 8in. or 9in. focus for general purposes, groups, instantaneous work, etc., and a single lens of 11in. or 12in. focus for distant landscape work.

If only two lenses are needed, the wide-angled and the rectilinear may be selected; the half combination of the wide-angled lens may then be used for distant views—it will give a focus of 10in. or 12in.*

---

* When using the half combination of any lens, it must always be remembered that whilst the focus is *doubled* the time of exposure is nearly, but not quite, *quadrupled*.

If the flanges of the set of lenses are not all of the same size, adapters should be fitted, so that only one movable front need be carried.

The threads of the screws of most lenses have wedge-like commencements which make it sometimes awkward to engage the one in the other. Messrs. Taylor, Taylor, and Hobson have introduced an arrangement by which the thread starts abruptly at full section, and the usual difficulty is thus avoided.

18. **View-centerers or finders.***—For certain subjects a view-centerer, or, as it is commonly called, a "view finder," is indispensable. When an ordinary stand camera is used for moving objects such as animals, ships, or boats in motion, it must often be moved a little from side to side after the dark slide is in position, so that the object may be in its proper place on the plate at the moment of exposure. This the view-centerer or finder makes it possible to effect.

View finders which consist of a double concave lens in a shallow metal setting fixed at the *top* of the camera back require to be used with care, as unless the eyes are kept exactly opposite the axis of the lens it is difficult to avoid side vision, and the positions of the objects as thus seen in the finder will not correspond with their actual places on the sensitive plate. They are, however, cheap and portable, and useful for work not requiring great accuracy.

View finders of the "camera obscura" pattern are to be preferred. In these, if they are properly suited to the focus of the lens used in the camera, the image, although smaller, should include exactly the picture that will appear on the negative. Many finders of this pattern are made far too small, and the lenses are not sufficiently powerful to give a bright image.

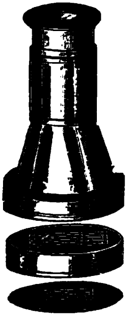
Fig. 2.

19. **View meters.**—These are simple bits of apparatus for finding readily what amount of subject would be included on the plate; they enable the operator to quickly select the best point of view, and they save the needless labour of frequently setting up the camera. A good pattern is shown in fig. 2. By joining the forefinger and thumb of the right hand and looking at the view through the circle thus formed, a good general idea of the picture given by most ordinary lenses is readily obtained.

20. **Spirit level.**—In taking pictures which include straight lines, the

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* The term "view finder" is vaguely used for two somewhat different things, one being an instrument attached to the camera for indicating when moving objects are in the required position on the plate; the other is a simple meter for carrying in the pocket, and is used for seeing what view the camera will take. The terms "view-centerer" and "view meter" are more appropriate.

camera must be level from side to side; and however much the *base-board* of the camera may have to be inclined (from front to back) in order to take certain subjects, the dark slide and focussing screen *must* be accurately vertical. It is also desirable that the front frame should likewise be upright, but this is not always possible with cameras of ordinary pattern. It must, however, be remembered that tilting the camera in this way has the effect of throwing the lens out of the centre of the sensitive plate, and that, unless the lens is large enough to cover more than the bare dimensions of the plate, some portions of the image will be indistinct. Hence the value of having a lens of a size to cover a plate larger than the one for which the camera is made.

After trying all the patterns usually supplied by photographic dealers, I have found that a four or six inch *mason's level,* which has both horizontal and vertical bubbles, is by far the best. With it, a camera can be rapidly and most accurately levelled, which is *not* the case with the small levels usually sold. It is specially useful for interiors—see fig 3.

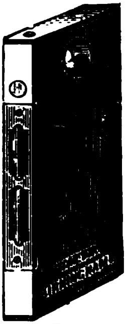

Fig. 3.

21. **Magnifying glass for focussing.**—One of ordinary make is sufficient for most purposes; the more elaborate patterns are specially useful for photo-micrography and enlarging. A pair of powerful spectacles may be used instead of a magnifying glass, and have the advantage of leaving the hands at liberty.

22. **Sky shade.**—A sky shade to the lens, in some shape or other, is most desirable. Those of the ordinary kind are made in the shape of a light square or oblong case of full size of the camera front to which they are fixed; they thus protect the lens from undesirable light coming from every side, and if made so as to be easily detached from the camera, and to fold up, they are the most effective, though somewhat bulky. Smaller contrivances that shade the sky only are also used, and a suitable arrangement may, with a little ingenuity, be attached to many shutters.

23. **Quality.**—The warning against buying flimsy apparatus cannot be too often repeated. No good work can be done with inferior tools. At the same time, the very expensive cameras are not *necessarily* the best. Where economy is desirable, restrict the *quantity* of apparatus, but let what is bought be of thoroughly good *quality.*

THE HAND CAMERA

24. When hand cameras were first introduced, it was the fashion to decry them, and there can be no doubt that, in the hands of many, the hand camera was a mere toy, and the pictures taken therewith were, in most cases, altogether devoid of merit. Longer experience has, however, proved that exceedingly good work can be done with a suitable instrument, and that, for certain subjects, the hand camera is indispensable.

25. There are two distinct varieties of hand camera, viz., the "*fixed focus*" and the "*focussing*" hand camera.

26. **Fixed-focus hand cameras.**—Mainly on account of their comparative cheapness, many hand cameras in general use are of the fixed-focus variety. They have the advantage of being cheap and portable, and they require less skill in using than the focussing type, but they have the disadvantage of unavoidably straining the perspective, owing to the necessity of using lenses of short focus.

27. **Focussing hand cameras.**—But, as pointed out in the first edition of this manual, some means of accurate focussing, and the use of lenses of sufficiently long focus, are essential to a *perfect* hand camera, and this has since been so fully recognised that there are now numerous hand cameras of "twin lens" and other focussing types, the only bar to their more general use being—in the case of twin-lens cameras—their greater cost and increased bulk.

28. Focussing hand cameras are also of two kinds—viz., those focussing by a scale fixed to the instrument, and those having two lenses, the upper of which shows the picture of full size, and with sufficient clearness to focus by.

29. A hand camera which focusses by scale need not be larger or much more expensive than a fixed-focus camera, the chief difference being in the greater focal length of the lens used, but to use it efficiently the operator needs to be able to "judge distance" accurately, and set his scale accordingly; this, however, soon comes with practice. In this form of apparatus the view finder is very small, and, as it must embrace the whole subject, the picture given by it is very minute.

30. **Twin-lens hand cameras.**—But where neither an increase of size nor greater cost is prohibitory, the twin-lens hand camera is by far the most efficient instrument. The advantages of this form of apparatus are as follow:

(1.) It is possible to focus after the plate is in position and up to the moment of exposure.

(2.) The view finder shows the picture the full size of the plate used, and with the utmost clearness.

(3.) The lens or lenses are specially adapted for this class of work, and generally have an arrangement for readily altering the size of the aperture.

(4.) The shutter is of easy adjustment for varying exposure, and the release should act without danger of shaking the apparatus.

31. The above points will now be considered in detail. The two lenses must be very accurately paired.* The upper half of the camera acts solely as a view finder, and shows the picture of the *full size;* the lower half is for the exposure only. Both lenses are actuated by the same rack, so that the picture may be kept constantly in focus up to the moment of exposure.

32. The lens should be quick-acting and capable of covering with full aperture the next size larger plate to that used in the camera, *i.e.*, for a quarter-plate the lens should cover 5in. × 4in. perfectly.

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* It might be thought that a less perfect lens could be used in the upper or view-finding part of the camera; but when it is remembered that all the focussing is done through this view finder, the necessity of a good lens working with a large aperture is apparent. A polished silvered plate, or a plate of speculum metal, would reflect the image better than the looking-glass now used, but it would require frequent cleaning.

33. The position of the shutter in a hand camera must depend upon the pattern of the shutter used. As a discharger the pneumatic ball is to be preferred to the usual trigger; it is more conspicuous, but is much less likely to jerk the apparatus.

34. The plate or film holding arrangement for the hand camera may be either an ordinary dark slide, a magazine, or a roller-slide for flexible films. I myself prefer the ordinary double dark slide.

The necessity, or otherwise, of a swing-back for hand cameras has been much discussed. It is valuable for architectural or very near subjects, such as animals, etc., but the introduction of a swing-back into some patterns of hand cameras is difficult.

It is an advantage to have the lower lens fixed ⅜in. higher than the exact centre of the plate, thus cutting off foreground, which in most instances will be found in excess of what is needed, or a rising front may be added.

35. The successful working of a hand camera is, in many cases, greatly facilitated by some suitable support. A tripod is quite inapplicable, but a light leather strap round the neck and buttoned to studs on the side of the hand camera will be found very convenient. Supported by this the camera can be held firmly against the body and still moved from side to side with ease and certainty. A good-sized level, fixed to the top front, is, by some, found to be useful in ensuring a level horizon.

36. It will be gathered from these remarks that a really perfect hand camera is a somewhat elaborate instrument, and also that the "detective" or concealed idea is altogether ignored. It rarely happens that a hand camera can be used without being noticed, and it is unwise to sacrifice essentials for a supposed advantage which is so seldom attained.

37. But a camera such as that described above would cost a sum that would be beyond the means of many. It is therefore a satisfaction to know that very good work can be done by comparatively cheap apparatus. The skill required to use an inexpensive instrument is greater, and the failures must necessarily be more numerous, but much amusement may be got out of very primitive hand cameras.

ON THE INTELLIGENT USE OF THE HAND CAMERA.

38. Those who desire to use a hand camera effectively must not expect that, with a so-called fixed-focus lens, every part of a picture comprising within itself objects such as figures, distant ten, twenty, fifty, or more feet from the camera, will be in accurate focus. The makers of hand cameras practically acknowledge this by attaching a focussing scale, graduated from a few feet to extreme distance. It is necessary, therefore, when using such cameras, to endeavour to get the points of most interest in the picture *into the same plane*, or as near to it as possible, and this is also desirable even with cameras of the twin-lens pattern, where the picture

is seen of the full size, and focussing is done up to the moment of taking the picture.

39. The following remarks refer especially to hand cameras of the twin-lens pattern, but are generally applicable to most hand cameras.

A camera cannot be held without movement for more than about one-eighth, or at the most one-quarter of a second, except when supported by a stick, or steadied by some other means.

Provided the breath is held whilst exposing, no blurring results from the insensible movement of the body. There is, however, a kind of movement that must be carefully guarded against. Many persons when squeezing the pneumatic ball or touching the button unconsciously jerk the whole body, just as a schoolboy does when firing a gun. Movement of this sort is liable to affect the sharpness of the image.

With twin-lens cameras the focussing is done on the reflected image shown (full size) on the ground glass, but as the ordinary focussing glass cannot be used, magnifying spectacles must be worn, being selected of sufficient power to give a clear image on the ground glass.

40. *Exposing.*—When taking *moving* objects, the *time* that can be allowed is the *essential factor;* the stop must be regulated by the time which can be given and the rapidity of the plate.

It must also be remembered, with moving objects, that the nearer the object is to the camera the greater is the effect of its movement on the plate; also that objects passing directly *across* the front of the camera show far greater movement than those travelling either towards or away from or at an angle with it. There are rules for finding the least distance at which objects moving at different rates may be taken without any appreciable blurring of the negative, but as calculations cannot be readily made in the field, the following table, applicable only to the *brightest summer light*, will be some guide:

At 200	yards—	A boat race or cyclist, f/11 or f/12	$\frac{1}{100}$	second.
,, 50	,,	A man walking fast, or an animal in quick motion, f/8 or f/9	$\frac{1}{100}$	,,
,, 15	,,	Animals in ordinary movement, f/8 or f/9	$\frac{1}{50}$	,,
,, 15	,,	Boat rowing slowly, f/8 or f/9	$\frac{1}{50}$	,,
,, 10	,,	Animals and figures moving slowly, f/8 or f/9	$\frac{1}{40}$	,,
,, 5	,,	Animals still, or a standing crowd of people, f/8 or f/9	$\frac{1}{25}$	,,

41. On account of their superior flatness of field and depth of focus, larger apertures can be used with the modern lenses of Jena glass than with any other.

The operator must decide beforehand whether his negatives are to be used for direct printing, in which case comparatively large stops can be used, and fuller exposures given, or whether they are to be used for enlarging or lantern slides, which require smaller stops to obtain great sharpness in the negative.

Light.—Bright diffused light will be found to be far better than actual sunshine for most subjects—it is almost, if not quite, as actinic, and gives softer shadows, and a far better picture.

42. *Development.*—The metol developer (see para. 162) is perhaps the most generally used for developing hand-camera negatives—but any developer may be used to which the worker is accustomed. Metol is especially valuable for short exposures, and will often give a good printing negative when pyro development would have possibly produced harsh results. But the appearance of a metol-developed negative is apt to be somewhat deceptive; the high lights prove, in printing, to be less dense than they seem.

43. *Films.*—For many reasons thick celluloid films are often preferable to glass, especially when on a journey. They are now made nearly as rapid as glass plates.

Roller films are somewhat troublesome to develop owing to their tendency to curl immediately they touch the developer. To remedy this, have a number of pieces of glass slightly larger than the films, smooth the sharp edges with the emery rubber (para. 200), and attach each film to a glass with two thin elastic bands, which must of course be put at the extreme ends of the film negative. The glass need not be detached from the film till after its removal from the fixing bath. Or the roller films may be soaked before development for five minutes in a dish of cold water till they lie quite flat.

LENSES AND SHUTTERS.

44. Space will not admit of descriptions of the great variety of photographic lenses, but a few words on the kinds most suitable for certain purposes may be of use. Speaking roughly, photographic lenses may be divided into the wide-angled, the medium-angled, and the long-focus or narrow-angled. See table of angles at para. 390.

45. **Wide-angled lenses.**—Now that the conditions under which successful photography is practised are more generally understood, the rage for the wide-angled lens for use *for all purposes* has fortunately subsided. But for interiors, and for architectural subjects in confined situations, a rectilinear wide-angled lens is still necessary, though it is more seldom used than any other.

46. **Medium-angled lenses.**—These are usually made of the rectilinear type, and are the most generally useful for all purposes. When the novice proposes to commence with only one lens, it should be of this sort.

47. **Narrow-angled or long-focus lenses.**—These lenses are the most suitable for landscape work, especially for *distant* views. They do not exaggerate the foreground and dwarf the distance, as do very wide-angled lenses, and though they include a much smaller angle of view, the subject is rendered in far better proportion.

The telephotographic lens is useful in special cases for very distant objects. When using it the atmosphere needs to be reasonably free from haze.

48. The picture overleaf shows the same subject taken on a quarter-plate, with lenses of 3½in. and 6in. focus respectively, and gives a better idea of what is meant than any verbal description. The views also teach a lesson regarding the necessity of selecting a lens to suit the subject to be taken. It will be seen that in the view taken by the comparatively wide-angled (3½in.) lens (which is properly suited for *close* objects only) the distance is dwarfed. In the view taken by the 6in. lens, the building is in

better proportion, but some portion of the view has disappeared. In the latter case, the camera should have either been moved farther back, or, if this was impossible, a lens intermediate in focus between the 3½in. and 6in. should have been used.

49. There is much vagueness in the use of the terms "quick" and "slow" when describing different lenses. For practical purposes, lenses of all kinds may be considered to work *at the same rate of speed with the same relative aperture.* Thus a portrait lens, or a rapid rectilinear, or a single landscape lens, if all used with the same relative stop (say f/16), will all take a picture in *nearly* the same time, but the portrait lens is capable of working efficiently with an aperture of, say, f/4, whilst the landscape lens will not perhaps work with any stop larger than, say, f/16; hence, the portrait lens can be worked *actually*, though not *relatively*, at a higher speed.

The rapidity of a lens is proportionate to the square of the aperture of the diaphragm with which it is being worked. With stop f/8 a lens works four times as fast as with f/16. Thus—8^2 : 16^2 or 64 and 256, or as 1 to 4.

50. **Care of lenses.**—It should be remembered that some of the optical glass of which lenses are made is comparatively soft, and readily suffers from careless usage; each lens, when not in use, should therefore be kept in a case with tight-fitting cover. Lenses should be cleaned only when necessary, first dusting them with a camel-hair brush, and then gently polishing with a piece of optician's soft chamois leather, *loosely rolled up.* Any marks not removed by the above process may be touched with alcohol and then polished with the leather. The chamois leather should be kept free from dust in a stoppered bottle.

A lens which has become dusty, or clouded with condensed moisture, is a frequent and often unsuspected cause of fogged negatives.

51. Lens caps should fit easily. To prevent their getting lost, it is a good plan to attach to the middle of each lens cap a small brass ring. A silk cord or light metal chain, with a safety pin at one end and a spring catch at the other (like those used for securing eye-glasses), is then fixed by the safety pin to the focussing cloth, and the spring catch passed through the brass ring on the lens cap. If the lens cap should be mislaid, a soft travelling cap, or the focussing cloth, is a fair makeshift.

52. When the diaphragms or "stops" are of the Waterhouse pattern, the series for each lens should be loosely riveted together by a pin through the tongues. Experience proves that when thus riveted they are not so liable to be lost. The "Iris" diaphragm does away with the inconvenience of detached stops, but diaphragm shutters cannot be used with it.

53. The marking of diaphragms is based on the proportion between the *diameter* of the circular opening in the diaphragm and the focal length of the lens, being expressed as a fraction, with f (focal length) as the numerator, and the proportion which the diameter of the diaphragm bears to the focal length of the lens as the denominator, thus f/4 signifies that the diameter of the aperture of the diaphragm so marked is one-fourth of the focal length of the lens. There is also a corresponding series of *numbers;* both are here given:

1	2	4	8	16	32	64	128	256
f/4	f/5·65	f/8	f/11·31	f/16	f/22·62	f/32	f/45·25	f/64

The f series is the most convenient, and is the one generally used. The Zeiss and other foreign lenses are numbered somewhat differently.

All diaphragms should be numbered according to this "*uniform system*," and in comparing notes with others, the f series only should be quoted.

54. **Position of shutter.**—There are four positions in which a shutter can be fixed, viz.: (1) Immediately in front of the plate; (2) just behind the lens; (3) in the diaphragm slot; and (4) on the hood of the lens.

Many authorities tell us that, theoretically, the best place for the shutter is immediately in front of the plate, and the so-called "focal plane" shutters have therefore been introduced; but for this position both camera and shutter have to be specially arranged, and it is not therefore so often used as other patterns.

Shutters (especially those for hand cameras) are sometimes fixed to the front board of the camera immediately behind the lens, but for this the camera must also be specially adapted.

55. **Diaphragm shutters.**—Of detached shutters, those working in the diaphragm slot are said to be in the most favourable position, but diaphragm shutters which are of the pattern which open from the centre generally require the lens mount to be cut, or an extra mount supplied.

Of diaphragm shutters which can be used without altering the lens mount, Newman's may be taken as a type, but it has the inconvenience that the stops cannot be changed without taking off the apparatus, and it is sent out with only one diaphragm. It is, however, on the whole, an excellent shutter, though not very fast.

56. **Hood shutters.**—Of shutters affixed to the hood in front of the lens, those on the roller-blind principle, such as Thornton-Pickard's, are most generally approved. They are light, compact, simple, and sufficiently fast. The speed is regulated by turning a screw, which winds up the actuating spring, and a "speed indicator" may be affixed.

57. Certain precautions need to be taken when using shutters. With all those on the "go and return principle" the use of a small stop decreases considerably the time of exposure; thus, with Newman's shutter, when using the f/22 stop, the index must be set at fifty per cent. above the time indicated on the shutter scale.

Roller blind shutters will not always exclude bright light for any considerable time. The slide should not therefore be opened until about to expose, or, in the case of a stand camera, a folding flap may be hinged to the top of the shutter, and only lifted just before exposing. A hole in a blind shutter may be repaired with a bit of court-plaster.

The above brief outline will enable the purchaser to choose the shutter most suited to his wants. There are many excellent shutters in the market (and some very useless ones), but in a treatise of this nature reference can only be made to *types*.

SUBSIDIARY APPARATUS.

58. **Notebook of exposures.**—Every exposure should be noted *on the spot*, as a guide both to development and to future practice. The notebook should be small, and *have a suitable pencil attached*. Small printed books,

ruled for the necessary data, are sold by most dealers; but they not unfrequently want a very important part, viz., the pencil.

59. **Changing-bag.**—This may be made of one thickness of black sateen and one or two thicknesses of red twill. It should measure about 3ft. long by 3ft. wide, and a tape should be run into a hem in the open end as in an ordinary bag. From the centre of one of the sides, a piece about 6in. square is cut out, and a double or treble thickness of deep yellow or orange Persian silk, or one thickness of canary and one of orange medium, inserted. The bag is put over the head, and the slides and plates being taken in, the string is tied tightly round the waist, to exclude all light.

For those who dislike the plan of putting the changing-bag over the head, it can be modified by sewing up the fourth side and attaching a sleeve, with elastic round the opening, to each of the two outer seams, the window also being omitted. The changing must then be done by *feeling* only. The splashes of emulsion on the back of the plate, together with the comparative coldness of the glass side, is a sufficient guide for many operators. By those less experienced, a small wafer may be affixed to the corner of the back of each plate, this being done in the dark room before leaving home. Beresford's Paragon changing-bag is a useful form.

60. Changing bags are only necessary when it is required to change plates in the open or by daylight. Most plate changing is done at night, in an ordinary room, with the blinds pulled down, and with a portable non-actinic lamp to give sufficient light. On emergency, plates may even be changed without a special lamp—a candle may be placed on the floor, and the direct light shaded by an open book, the plates being changed with the back to the light—a sheet of yellow paper round the candle makes it safer. Plates may also be changed at night, in the open air, by moon or starlight.

61. **Spring-carrier for cyclists.**—For those who combine photography with cycling, there are several forms of spring carrier on which small cameras can be conveniently carried.

62. **Apparatus for field development.**—Very little need be carried for this purpose. Three or four celluloid dishes and a celluloid developing cup, a folding washing rack, a few sheets of canary medium, sufficient developing tabloids and hypo cartridges, are all that are really needed; and, in case of loss, there are ready substitutes, for developing can be done in a shallow pie-dish, and a wine-glass or small tumbler answers as a developing cup. The washing rack may be immersed in a bucket or earthen pan, or in the nearest running stream. A large tablespoon holds about an ounce, a dessertspoon half an ounce, and a teaspoon a dram of liquid, whilst the half-crown weight half an ounce, the sovereign a quarter ounce, and a new halfpenny one-fifth of an ounce.

63. **Tourist's hamper.**—A debatable point is how best to carry the apparatus when on tour. Very small cameras may be packed in the portmanteau, or carried by hand. But even with a half-plate camera, it is a great convenience to have a single wooden box or strongly-made wicker hamper, which shall contain camera, plates, and all subsidiary apparatus. This box or hamper, if carefully packed, will travel safely in the luggage van, and the plan will often prevent the mislaying of some portion of the photographic outfit.

CHAPTER II.—ON AIMS, &c.

64. The photographic art has so many ramifications that it must be conquered *in detail*, and the beginner who, tempted by the absorbing interest of the subject, dabbles simultaneously in all its branches, only courts failure. For the "past master" in the art no rules are needed, and to him the following remarks do not apply, but the tyro will do well to study and act upon them.

65. **On specialism.**—In photography, as in other things, the specialist has the best chance of success. He devotes his whole time and energy to one branch of the art, and is therefore more likely to be pre-eminent in it. Some continue to be specialists during all their art-life, but this is neither necessary nor possible for all. When the first chosen section has been thoroughly mastered, then, and not till then, another may be taken up, until at length the worker, although always a specialist for the time being, becomes ultimately proficient in all the branches of the art. Select, therefore, the line you intend to work on in the first instance, and resist the temptation to wander off into byways that lead from the object in hand.

66. **On method.**—Even after certain definite aims have been laid down, success will be found to depend much on methodical working. The man who works systematically will not only do far more in the same time, but will, as a general rule, do it far better than one who is less orderly.

This is desirable even in small things; there should be a place for everything, and everything should be kept in its place; developing dishes and glasses should be washed after each day's work, bottles should be labelled immediately they are filled, and so on.

67. **On thoroughness.**—The camera should never be set up merely to make a negative. The subject to be photographed should be studied, and be worthy of record and of your aspirations. The slide should never be drawn until the lighting of the picture is what you think it ought to be. Your aim should be to make *pictures*, not merely *negatives*. Anyone after a few days' practice can make a technically good negative, but much thought, consideration, and labour are required to make an artistic picture.

In like manner never allow a print to go out that you do not consider to be in every respect the best you can do. "It's good enough for an album" is not a valid excuse for disseminating inferior work.

68. **On over-production.**—A *perfect* photograph is as difficult to produce, and is as rare a product, as the best work of many artists. Good work cannot be turned out wholesale. A single good negative is a more satisfactory reward for a week's work than a dozen second-rate pictures.

If subject to the temptation to expose recklessly, it is a good plan to restrict within narrow limits the number of plates taken out when starting for the day's work; greater discrimination in making exposures is likely to result.

69. **On firing shots.**—How often do workers say to themselves, "It isn't *quite* the thing, but I may as well expend a plate on it." Now nothing in the whole range of photography is more prejudicial to true artistic work than this indiscriminate "shot-firing." Knowing beforehand that the picture is not likely to be good, the worker is liable to be careless in selecting the point of view, inaccurate in judging the correct time of exposure, and listless over the development. He thus encourages a loose and negligent style, fatal to all excellence.

70. **On prospecting.**—Pictures are not to be picked up without trouble. To take the camera and wander out to see if you can come across "anything worth taking" is not often the best plan. When time admits, it is preferred by many to devote a day to a preliminary survey, to select the pictures carefully, and to make a note of each subject, specifying the time of day when the light would be suitable: then, when actual camera work commences, no time or precious light is lost, and the fatigue is greatly lessened. The uncertainty of our climate is, however, so great that it is as well to take the camera even when prospecting, lest an opportunity of securing some special effect be missed.

71. **On looking near home.**—Many there are who reserve all their photographic energy for a summer or autumn trip: they overlook the many effective pictures close to their hands, and only realise the picturesqueness of their own surroundings when some artistic friend comes to prospect in their vicinity. "There is more merit, more material, and a better *photographic* picture to be got out of the ingredients afforded by a rustic lass, a shabby pool, with a few rushes straggling through it, and two or three bits of rock lying around, than from all the Martin-like plains and grandest Alpine scenery in Europe."—*Lyd. Sawyer.*

72. **On composition.**—On this subject much has been written which is, doubtless, very instructive to the professionally-trained artist, but which often conveys to the ordinary photographic worker no very definite ideas. Most educated men instinctively recognise a pleasing picture when they see it, though they may find it sometimes difficult to describe in set words why it is effective.

There are certain leading rules governing composition which everyone commencing photography should study, and there are many popular works on the subject.

Into the respective merits of the "sharp focus" and "blurred" schools it is not proposed to enter, but the latter school, in spite of all the exaggeration which has characterised both its doctrine and practice, has taught the lesson that, in the composition of a picture, the arrangement of its masses of light and shade is of even more importance than perfection of detail.

73. An excellent way of judging of the general effect of light and shade in a finished print is to view it from such a distance that the masses rather

than the details are seen. It is surprising how often a distant inspection of this sort discloses the secret of the success or failure of a picture.

74. **On failures.**—In photography the most instructive and encouraging things are the failures!—not those caused by carelessness or negligence, but those which must be acknowledged to be failures even after every care has been taken. All photographers should be, and generally are, rigid critics of their own work, because the mechanical part of the process is so comparatively easy that they feel that their productions must be judged chiefly by the artistic results attained. A failure which is only just short of a high ideal is an encouragement to further effort.

A well-known specialist in animal photography relates that he had taken more than eighty negatives of a favourite subject before he got one which *quite* satisfied him. This represented infinite labour, considerable time, and no little expense, but the one unqualified success, after so many attempts, more than repaid him.

Keep, therefore, a very large box for waste negatives, and ruthlessly sacrifice all inferior work. Endeavour to hide from critical examination and comment failures that you are likely to be ashamed of later on.

75. **Photography for painters.**—For many years it seemed a point of honour with painters to depreciate photography. Of late this feeling has changed, and many of our best-known artists largely use photography for collecting data. For rapidly-moving objects photography is invaluable to them. The eye can scarcely follow the rapid advance of the breaking wave, but the lens seizes and records it accurately for future reference. Photographic notes of clouds, foregrounds, figures, etc., can be made when time and circumstances do not admit of a prolonged study of them on the spot.

CHAPTER III.—PLATES AND FILMS.

76. Fortunately for the photographic public, most of the plates in the market are of excellent quality. The question of thick or thinly-coated plates or films needs only to be discussed.

The thickness of coating necessary for a good plate is governed by the fact that, during exposure, the light penetrates into the thickness of the sensitive film to a depth proportionate to the brightness and duration of the rays falling on each part of it. During development the action is again proportionate to the previous penetration of the light, and the emulsion is gradually blackened deeper and deeper until the strongest lights are visible on the back of the plate. If, when the development has proceeded as far as this, the details in the shadows are fully out, the coating is quite thick enough, and any additional thickness beyond this is of no value.

But if, when the high lights show clearly on the back of the plate, the shadows have not fully appeared, then the coating is too thin, because there can be no additional deepening of the high lights, and the further development necessary to bring out the shadows causes the middle tints to overtake the high lights, and gradation is thus impaired. It is, of course, presumed that the plate has had an accurately-timed exposure.

For interiors, and subjects liable to halation, the coating can hardly be too thick.

77. **Colour-sensitive plates.**—The preparation of orthochromatic, isochromatic, or colour-sensitive plates, is based on the treatment of ordinary gelatino-bromide plates with certain dyes which make them sensitive to parts of the spectrum by which they were before but little affected.

The ordinary gelatino-bromide plate is comparatively insensitive to reds, yellows, and greens, which make but a trifling impression on the film, and are consequently represented by a deep shade of colour in the final print. This inversion of tone (by which, for instance, bright yellow is converted into sombre black) alters the true "values" of pictures in which these colours predominate. On the other hand, the blues and violets act on the gelatine plate with exaggerated effect. The problem of isochromatism is to increase the action of the reds, yellows, and greens, and to reduce the undue potency of the blues and violets.

78. **The yellow screen.**—But whilst the process of orthochromatising the plate has made it more sensitive to the reds, yellows, and greens, and thus solved one part of the problem, it yet remains to devise some process for lessening the undue activity of the blue and violet rays. *This is the duty of the yellow screen.*

As the effect of the yellow screen is proportionate to its *depth of tint*, it is manifest that if this be made too deep, the blues and violets may be *over-corrected.* A judicious selection of the right tint of yellow screen to suit the special subject, and also a recognition of the circumstances under which the screen can be safely and even advantageously dispensed with, is of great importance, and many of the conflicting opinions which exist on this matter are attributable to an unintelligent use or misuse of the yellow screen.

79. **Screen: when to be used.**—A careful consideration of what has been said above will indicate the circumstances under which the screen should be used with the orthochromatic plate.

In seascapes, which are composed principally of blue sky with white clouds and breakers, and perhaps a foreground of white sand; and in snow scenes, in which the predominant colours are likewise white and blue, the yellow screen subdues the too energetic action of the blue, and produces the natural equivalent of that colour in the picture.

For views with hazy distance, particularly in winter; and for Alpine scenery, especially if including far-off mountains, the screen should be used.

In copying paintings, especially those in oil colours, the yellow screen is indispensable.

80. But for views taken in the early morning or late evening, where there is already much yellowness in the light; for copying by gas or paraffin light, which is of a more or less yellow tint, the screen is not required with the orthochromatic plate, nor need it be used in ordinary landscape work.

81. **Patterns of screens.**—There are two patterns of yellow screen in general use. One consists of a light metal frame carrying the yellow glass; this is fixed on the inside of the camera front, and is available for all lenses likely to be used in the same camera. The other pattern is a circular bit of yellow glass, set in a metal flange, which readily screws on to the back of the lens.

Slips of yellow glass, the margin masked with black japan to the correct sizes of the circular apertures, may be used in place of the ordinary Waterhouse diaphragm; or thin collodion or gelatine films, coloured yellow, may be attached to the openings in the metal stops; but these plans are not so effective as the others mentioned above.

82. **Exposure and development of orthochromatic plates.**—These plates should have *full* exposure to secure soft negatives. They will bear considerable over-exposure, but an under-exposed orthochromatic plate is even more intractable than an ordinary under-exposed plate.

Being fully sensitive to the yellow rays, and to a small extent to the red also, they must be handled and developed in ruby light, and shielded even from this as much as possible.

When a pyro developer is employed, carbonate of soda or potash should be used, instead of ammonia, which latter tends to fog many brands of isochromatic plates; and as these plates rapidly gain density, the developer should be made weaker than for ordinary plates. Orthochromatic plates (especially when used with the yellow screen) appear to lose more during fixing than ordinary plates, and should therefore be more fully developed.

By many, amidol or metol, or mixed eikonogen and quinol, are preferred to pyro as developers for orthochromatic plates.

83. **Ordinary plates with yellow screen.**—When orthochromatic plates are not available, ordinary plates may be used with the yellow screen, and for clouds, seascapes, and similar subjects, the results are decidedly good; in fact, there are some who consider that pictures of this class on ordinary plates with screen are quite equal to those on orthochromatic plates without a screen.

84. **Collodion dry plates.**—For the guidance of those about to use Dr. Hill Norris's plates, a few notes of our first experiences are here given.

The best results are obtained by an approximately correct exposure, and this is easily ascertained by a trial plate.

For landscape plates of medium rapidity (yellow label), the exposure with a good autumn light (October-November) on an ordinary landscape with f/32 is about six seconds between the hours of eleven ond one o'clock.

It is essential that the developer and dishes be kept at an uniformly warm temperature (say 60°). If the developer is allowed to fall much below this, plates which have really had correct exposure will develop as if under-exposed.

An eikonogen developer is well suited for collodion lantern plates. Pyro and soda is an excellent developer, but in winter it is best to abstain from the use of quinol, which is very inactive in cold weather.

85. **On plates generally.**—When working continuously, it is always desirable to lay in a good stock of plates *of the same batch*. Odd dozens bought from time to time are apt to vary in quality, even though coming from the same maker.

86. Plates should be carefully dusted before being put into the slide. The simplest way is to blow both slide and plate with a rubber puff-ball. Failing the above, a loose pad of *cotton* velvet is preferable to the camel-hair brush often used, as the latter easily becomes electric, and attracts more dust than it removes.

If plates—especially very sensitive ones—are allowed to remain too long in the dark slides before exposure, they will almost certainly fog under development. If, after the day's work is done, any plates remain in the slides, and are not likely to be required for several days, they should be taken out and replaced in the boxes in which they came.

87. **Numbering of plates.**—When working away from home, and reserving development till after return, every plate, as it is placed in the dark slide, should be labelled with pencil on the margin of the film side with a *consecutive* number, which should be simultaneously entered in the "exposure notebook," together with the number of the slide; thus, 15-3 would mean that plate bearing consecutive number 15 would be in

No. 3 slide. The other columns of the notebook will, of course, be filled in against the numbers as exposures are made. The outer margins of sheets of postage stamps, cut to suitable size, are sometimes used for numbering plates on the glass sides, but the numbers come off during development. This recommendation is, however, only applicable when large plates are being used. In hand-camera work, where numerous plates are exposed in a short time, the numbering of each would be too tedious.

88. **Packing of undeveloped negatives.**—If development cannot be carried out immediately after exposure, the following plan is recommended: Each pair of plates should be put face to face, *with a sheet of stiff celluloid interposed between them,* and every four plates should be wrapped in a separate paper. They are then tightly packed into the pasteboard box in which they were originally received, and the whole wrapped in several thicknesses of paper, and labelled with the date of exposure. This I have found to be far better than using blotting or other paper; the celluloid sheets, being stiff, are more easily handled inside a changing-bag or in semi-darkness, and during many journeys I have never had a single scratched plate. Celluloid sheets of suitable size can readily be obtained, or spoiled film negatives may be thoroughly cleaned and used for the purpose.

FILMS.

89. Thick celluloid films are coated with the same emulsion that is used on the ordinary glass plates of the same makers. They are lighter and more portable than glass plates, and are almost as easily manipulated. Some celluloid has a fine mat surface on the side to which the emulsion is attached; this prevents the emulsion from stripping, which it is sometimes liable to do if flowed on smooth celluloid.

There is one very great advantage in using films—namely, that they can be safely and expeditiously sent by post to any part of the world, and thus photographers, when travelling abroad, can ensure the punctual receipt of fresh supplies, and can, if necessary, send back their undeveloped negatives to be finished at home.

90. Films should be kept, like plates, in a dry place, and away from gas fumes, but, above all, the films should not be subjected to *too much pressure.* On account of their being unbreakable, one is very apt in travelling to pile a great many things upon them, and this is often the cause of peculiar insensitive markings upon the negative.

91. For a long time there was a difficulty in finding a varnish suitable for films. This has now been overcome, and several good *cold* varnishes are now in the market.

Thick films may be used in any ordinary dark slide. They should be backed up by pieces of stiff millboard painted dead black. If this is not done the springs on the metal diaphragm are liable to force out the film and cause it to be scratched when the slide-shutter is drawn.

But when working films exclusively there is a great saving in weight by using the light slides specially constructed for films. These are generally made in the solid form (not opening book fashion), and with slide shutters to pull quite out. When using these slides it is necessary to remember that when the slide shutter is replaced in the slot after the exposure of the plate, it must be inserted *quite horizontally*, so as to engage the *whole length* of the slot at the same time. If it is held at an angle so as to engage one corner first (which is the *easiest* way), it will let in light and fog the plate. This remark holds good of *all* slides the shutters of which pull quite out

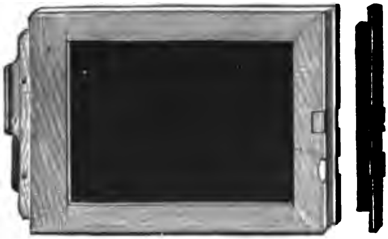


Fig. 4.

92. **Roller films.**—These films are made on a basis of very thin transparent celluloid, and, unlike the thick films, they require careful and special handling during development, and in the subsequent washing, drying, and storing—see para. 43.

To the tourist who works with the hand camera they offer advantages which are considered by many to counterbalance the additional trouble. Particular care is necessary to keep negatives on these thin films under pressure for a long time, until they have become thoroughly dry and hard.

The old stripping films, which fell out of use on the introduction of the celluloid film, are now being reissued.

93. **Storing film negatives.**—The simplest and best way of storing the thick films is to get a strongly-bound notebook, which, for quarter-plate size, may measure about 7 × 4½ inches. Begin by cutting out every third leaf, and then paste together the top and bottom edges of each pair of the remaining leaves, thus making pockets in which the film negatives are to be kept. By numbering each pocket and making an index at the end, any negative is readily found.

CHAPTER IV.—EXPOSURE.

94. The correct exposure to be given to ever-varying subjects requires much consideration, but fortunately there are some simple axioms which, if *thoroughly* mastered and *clearly fixed in the memory,* will be found to prove reliable guides.

95. **"Take time."**—But first a very necessary bit of advice is needed. It is simply to *take ample time.* Look at the subject in every possible way before deciding on the point of view, or the arrangement of figures most suitable. See that the picture composes well on the ground glass; the movement of the camera a little to one side or the other will often make all the difference between success and failure. With figures, and especially with animals, *wait* until the attitudes are natural and unconstrained. When taking landscapes in cloudy weather, wait half-an-hour, if necessary, for a bright gleam of light; in short, do every operation deliberately and thoughtfully.

96. **Duration of exposure.**—Speaking broadly, the length of exposure depends upon the following conditions:

1st. The sensitiveness of the plate.
2nd. The quality of the light.
3rd. The nature of the subject.
4th. The distance of the object.
5th. The aperture with which the lens is being worked.

97. *Normal exposure.*—It is necessary to have some *datum* with which the relative sensitiveness of plates may be compared. Any datum will do, provided it is fixed and unalterable. The one most generally used is the time of exposure required by the given plate when the lens is worked with an aperture of f/32, the subject being an open landscape with no near foreground and the light at its best. Thus A's plates require an exposure of, say, four seconds for the above subject, B's need three seconds for the same subject, and C's only want two seconds; then four, three, and two seconds are the normal exposures of A, B, and C's plates respectively, and from these normal exposures all other exposures for larger or smaller apertures can be readily calculated.

98. *Exposure as modified by the sensitiveness of the plate.*—The normal exposure for each kind of plate must be found by *actual experiment.* The sensitometer numbers marked on the packets are not sufficiently reliable.

A simple method of proving the speed of a plate is to direct the camera towards any evenly-lighted subject, to cap the lens, draw out one inch only of the slide, and give, say, half a second exposure. Cap the lens again, do *not* close the slide, but draw it out another inch, and give another half a second exposure, repeating the process until the whole plate has been exposed. On a half-plate thus treated there will be six degrees of exposure, varying from half-a-second (the last) to three seconds (the first) exposure. The plate after development will show which of the exposures was correct.

99. *Exposure as modified by the quality of the light.*—Space will not permit our discussing the varying actinicism of light. It will be sufficient to consider the effect which the altitude of the sun at various times of the day has on the lights and shadows of the landscape. "In the morning before ten o'clock the light is soft, the shadows are not too black, nor the high lights too bright. At noon, the sun being almost vertical, the shadows of objects are small, and there is a general want of breadth in the landscape. Late in the afternoon is the best time for pictures. The light is then soft, the shadows are not too dark, while the effect of the light striking objects at a shallow angle is to lengthen out the shadows, giving great variety and breadth of effect."

100. Some photographers prefer to work in brilliant sunlight, but "artistic pictures are independent of, and in fact generally better without, broad sunshine"; all depends on the subject. Sunlight gives a brilliant picture; good diffused light, a softer and often *a far better* image. Dr. Scott's table of the relative intensity of light is useful for occasional reference, and is therefore given:

Hour. A.M. P.M.	June	May or July.	April or August.	March or Sept.	Feb. or Oct.	Jan. or Nov.	Dec.
12	1	1	1¼	1½	2	3½	4
11 or 1	1	1	1¼	1½	2½	4	5
10 or 2	1	1	1¼	1¾	3	5	6
9 or 3	1	1¼	1½	2	4	*12	*16
8 or 4	1½	1½	2	3	*10		
7 or 5	2	1½	3	*6			
6 or 6	2½	*3	*6				
5 or 7	*5	*6					
4 or 8	*12						

* More for a *yellow* sunset.

The light at the seaside is usually far more actinic than it is inland, sometimes twice as much.

101. *Other modifications.*—There are other minor conditions which slightly nodify the time of exposure for landscape work. Thus, when the atmosphere is very *moist*, or immediately *after rain* or with *water in the immediate foreground*, *shorter* exposure is needed; but with an *east wind*, or in *thundery weather*, *longer* exposure is required.

102. If the light is directly in front of the lens, the plate will fog, unless the light is prevented from striking on the lens by an efficient sky hade; but with the lens well protected, the experienced worker frequently

secures very striking pictures with a front light. Light coming from behind gives a flat picture. Light from either side is better for ordinary work.

103. *Exposure modified by the nature of the subject.*—Taking, again, the "normal exposure" (as explained in para. 97) as our *datum*, we proceed to show how very materially the nature of the subject modifies the time of exposure required to obtain a good negative.

The "normal exposure" for an open landscape with no near foreground being taken as	1
Clouds will need only	from $\frac{1}{4}$ to $\frac{1}{8}$
Sea and sky	„ $\frac{1}{3}$ to $\frac{1}{4}$
Landscape, with heavy foliage in the foreground	„ 4 to 8
Dark subjects under trees will, according to the quality of the light, need	from 50 to 100 or even more.

It should be distinctly understood that the above scale of exposures does not claim to be more than a very remote *approximation*, but the vast difference between the two ends of the scale will serve to impress the vital necessity of carefully considering the nature of the subject on those who go out for a day's work and give "two seconds all round."

104. Subjects with *excessive contrast* should have a very *full* exposure; those which are naturally flat and *deficient in contrast* should be given a comparatively *short* exposure.

105. *Exposure as modified by the distance of the subject.*—If any object which is at a considerable distance from the camera is found to require an exposure of half-a-second, a similar object only half as far off should *theoretically* require four times that exposure, or two seconds (since light acts as the square of the distance), but to work on this supposition would be contrary to the experience of any person accustomed to take pictures. It is, therefore, a difficult subject to generalise upon, and a scale of exposure for different subjects at varying distances from the camera, to be of any use, would embrace so many types of landscape photography as to actually embarrass rather than assist the novice. But a rough scale of exposures may be made as follows:

No. 1.—*Open landscape.* That is, the ordinary landscape, with nothing near the camera.

No. 2.—*Near landscape.* The ordinary landscape, with objects of interest in the foreground.

No. 3.—*Close landscape* is where the principal object of interest is in the foreground.

Taking these three kinds of landscape, the operator when using rapid plates in bright weather in summer might give—for No. 1 with f/32 an exposure of a quarter of a second, for No. 2 half a second, and for No. 3 one second. This scale is, however, only intended as a rough approximation, which will be readily modified by anyone accustomed to take pictures and develop them intelligently.

106. But when we turn from landscapes to near figures or other close objects of which pictures are to be taken, the above scale would be of no help, as the objects are usually only a few yards or feet distant from the camera, and the relation between them and a landscape is as different as that between a portrait taken indoors and another taken outside in the full glare of sunlight; hence the exposure for such objects must be separately

considered, and the principle above alluded to, that *halving the distance quadruples the exposure*, comes into actual practice. Thus, if an object such as an animal or a figure at a distance of ten feet with a stop f/11 required, in bright light, one-eighth of a second, the same object at five feet would require an exposure of half-a-second. Larger objects would be more distant, and at, say, twenty feet, would need only $\frac{1}{32}$ second. These figures are merely approximate, and are only intended as a guide to the novice.

107. *Exposure as modified by the working aperture of the lens.*—When the lens stops are graduated on the uniform system (U.S.), as they *should* always be, each *smaller* stop requires an exposure of *double* that of the one next larger, whilst each *larger* stop needs only half the time for the one next smaller. Thus, if f/32 stop requires an exposure of two seconds with a given plate, f/22 (the next larger stop) will require only one second, whilst f/45 (the next smaller stop) will need four seconds, and so on.

108. The above instructions may appear somewhat elaborate, but in practice they will be found less complicated than they look at first sight, and the beginner should realise fully that until he has *thoroughly* mastered them he can never take a successful negative except by the merest chance; he is therefore recommended to study them *most carefully*, and to impress them clearly on his memory; he will then, after a very little experience, work with confidence, and be reasonably sure of satisfactory results.

109. **Exposure maxims.**—*The best test of the suitable lighting of the object to be photographed is its appearance on the focussing screen*, though the resulting negative will not be so bright as the picture on the ground glass. Many a picture that looks very promising to the eye is found to be altogether wanting when viewed through the focussing screen, *and when this is seen to be the case it is not of the slightest use to photograph it.* Without satisfactory lighting no good picture can be made, and, paradoxical as it may appear, the unaided eye is *not* the best judge of the suitable lighting of a picture; the focussing screen is a far surer and more reliable guide, and if the lighting of the picture as shown on the ground glass is not in every respect satisfactory, the attempt should be relinquished, and another aspect tried. *Too much stress can hardly be laid on this point*, as every experienced photographer knows full well.

By wearing neutral tint or blue glass spectacles when focussing, the relative values of the lights and shades of the picture are shown more nearly as they will appear in the negative, and the same result may be arrived at by tinting the focussing screen to a light blue shade.

The relative brightness of the image as seen on the focussing screen, when compared mentally with previous successful exposures, is one of the best guides to the amount of exposure required.

Focus with a large stop or with full aperture, and insert the smaller stops afterwards. *Let the exposure be sufficient for the deepest shadows; all else may be safely ignored.*

The cap of the lens should fit easily, and, when exposing, it should not be pulled straight out, but, using the upper part of the cap as a pivot, it should be opened from the lower side and the cap brought up into a horizontal position *above* the lens. It is then replaced by reversing the process: more exposure is thus given to the foreground, and less to the sky. Care should be taken to keep the arm clear of the lens.

Always expose two plates on any special subject, giving one of them a longer exposure than the other. By developing the shortest exposure first, a clue will be gained to the treatment of the second.

For exposures under half-a-second use a shutter. Longer exposures can readily be measured by mentally counting *one, two, three, four, five, etc.;* every five, counted *as rapidly as possible,* will be found to give one second.

110. **Quick or slow exposures.**—In taking views which include figures in motion rapidity is essential. Falling water or breaking waves *must* have quick exposure, or all crispness is lost, and the water becomes wool.

The question of quick or slow exposure resolves itself into one of rapidity of plates. With plates which are not only quick in recording the strongest lights, but are also relatively sensitive to the weaker rays which emanate from the subject photographed, there seems no reason why any limit should be put to rapidity of exposure. At the same time it must be remembered that quick plates allow less latitude in exposure than slow ones: for an extra quarter of second, which would only add *one-sixteenth* to a normal exposure of four seconds for a slow plate, would double the normal exposure of a quarter of a second for a quick plate.

111. **Latitude of exposure.**—From experiments made by Professor W. K. Burton, he deduces that "the permissible variation in exposure is very much greater than has hitherto been supposed." He found it "possible to vary the exposure as one to forty, and yet to get negatives giving prints that were identical." The same developer—pyro soda—was used in all cases, the proportions being modified as required by the amount of exposure given. Of two plates exposed on the same subject, one had three seconds, and was developed with one grain pyro and one-fifth grain bromide to the ounce of developer, the development being completed in five minutes; whilst the second plate had a hundred and twenty seconds exposure, was developed with eight grains pyro and ten grains bromide to the ounce, and took twenty minutes to complete, and yet the resulting prints from the two negatives were precisely similar.

On the other hand, Messrs. Hurter and Driffield dissent from Professor Burton's opinion, and state that, though with some plates exposures varying within certain limits will give negatives which will yield very similar prints, yet the negatives themselves will be of very different appearance, and they reiterate that "*there is one exposure, and one only, which yields a true representation with minimum density*"—see next paragraph.

112. A *full* exposure should always be given. "A plate, if not very greatly over-exposed, may sometimes be made up into a passable negative by judicious development; a plate much under-exposed is quite beyond remedy." This is the time-honoured rule, but the possibility of making an indifferent negative from an over-exposed plate must not be allowed to beget carelessness and a tendency to over-exposure, for it must never be forgotten that, though a much over-exposed plate may not be absolutely worthless, it can *never* be made into a *perfect* negative.

113. **Quality of negative.**—A bright, sparkling picture is the style most generally aimed at. To obtain this, the light must be bright, the plate must have just the right amount of exposure (neither more nor less), and the development must just stop short of hardness. Others desire a soft, delicate effect, and arrive at this by working in diffused light, giving a very full exposure and developing with weak solutions. Each class of negative has its admirers. After having chosen the style best suited to one's taste and mode of printing, it only remains to endeavour to obtain negatives of *uniform quality.*

It must not be forgotten that much of the brilliancy of a negative depends on the exclusion of all stray light from the inside of the camera. The bellows should be dead-blacked or covered with black velvet—see also para. 16.

HALATION.

114. In taking interiors, halation is a serious evil. Many are the remedies proposed. Ordinary thickly-coated slow plates are the best to use. A very rapid plate is peculiarly liable to halation. Emulsion coated on *ground glass* is said to be a remedy.

Numerous mixtures are recommended for application to the back of the plate, and these are efficient in proportion as their index of refraction corresponds with that of the glass. Most of them are, unfortunately, messy, and are difficult to apply and remove.

Caramel and burnt sienna is perhaps the most easily applied; it is somewhat troublesome to prepare, but may be purchased ready for use.

115. A mixture of equal parts of plain collodion and mat varnish, coloured with aurine, is clean and easily applied—it may be removed before development with a rag dipped in alcohol. Paper backings are not generally in favour, as it is difficult to press them into optical contact with the back of the plate.

Mr. Drinkwater recommends a mixture of benzine three ounces, brunswick black one ounce. It dries immediately, is sufficiently transparent to enable development to be carried on without removing it, and is easily cleaned off with rag and whiting.

When anything in the nature of a colour pigment has to be applied, a soft squeegee coated with the mixture and used like a printer's roller will be found a most convenient tool for laying on the composition evenly and quickly.

CHAPTER V.—TREATMENT OF SPECIAL SUBJECTS.

116. **Foregrounds.**—The selection of a suitable foreground is of the greatest importance. A good foreground often redeems what would otherwise be a tame and comparatively uninteresting picture. The foreground should be neither too close nor too dark. If too close, a very small stop must be used, and the time of exposure will be greatly lengthened; if too dark, the contrast with the distant landscape will be too marked. As a rule, the foreground should be the sharpest part of the picture.

When the natural foreground is out of proportion to the rest of the picture, the defect may often be remedied by lowering the camera almost to the ground; this will be found to foreshorten the foreground, and often to greatly improve it.

117. **Clouds.**—Characteristic clouds make very beautiful pictures of themselves; but apart from this, no landscape view is complete unless it has suitable clouds (which must frequently be printed in from a separate negative), and no artist is deserving of the name who fails to make his own cloud negatives for printing into his pictures.

The usual advice is to take clouds as near as possible to the sun (short of getting the sun's rays into the lens), and doubtless such clouds are generally more brightly illuminated. But when cloud negatives are required for printing with landscapes, they should be taken with the same lens, and should have the same kind of lighting as the views on which they are to be printed, and as such views are not so frequently taken with the sun in front of the lens, the advice to select clouds in every case near the sun is incorrect. It certainly saves the labour and the long waiting for suitably-lighted clouds in more natural positions: but the resulting negatives will not be found to be so useful as those taken with the light coming from one side or the other.

It should be remembered that clouds comparatively close to the horizon are those which usually appear in a picture, and these being secured, it must be recollected that the most characteristic parts of the cloud or clouds should be in the *upper half* of the negative, as this is chiefly used in printing. A little of the sky line should be included, to prevent the plate being accidentally printed bottom upwards.

Good clouds may be seen at any time during the year, and at any hour of the day; but the most favourable conditions are—after sunshine showers in April or May, and again in autumn; after heavy rain, or during or after a thunderstorm. Clouds are generally best in the afternoon and evening, and some splendid effects occur just after the summer's sun drops below the horizon. A sea-coast place is particularly favourable, as, not only are the clouds generally better, but there is a clear horizon.

The selection of the plate to be used will depend much on the *colour* of the clouds. Those with *grey* tints are as easily photographed as other distant objects by using a *slow* ordinary plate with a small stop, and giving from one-fourth to one-sixth of the normal exposure. But for thin, white, fleecy clouds on a pure blue sky, slow orthochromatic plates with a *light* yellow screen should be used, though ordinary slow plates will do, provided a screen of deeper tint is adopted.

If a plane mirror of black glass (called in the trade a "Claude Lorraine decreasing black mirror") is placed in front of the lens, so that its surface makes an angle of 33° with the axis of the lens, the image of the clouds reflected in the mirror may be easily photographed.

The camera should not be tilted more than can be avoided, and for this reason the top of a hill, with a clear horizon all round, is the best place for taking clouds. There is perspective in clouds as well as in the landscape beneath them.

Cloud negatives may be successfully treated with a pyro developer, diluted with one or two parts of water. Quinol is good for very thin clouds, and amidol or metol for those of every other sort. Cloud negatives develop very slowly, owing to the short exposure, and must have plenty of time to do them justice. If the clouds are required for printing on landscape pictures, the negatives should not be allowed to become too dense, though every detail in the shadows of the clouds should be brought out.

118. *Natural clouds in negatives.*—When the clouds are very well marked in the landscape, and have impressed themselves vigorously on the plate, they may often be kept within printing density by proceeding as follows: When the clouds have attained sufficient printing density during development, pour off the developer, wash the plate with water, and then tilt the developing dish with the foreground towards you. Now return a portion of the developer carefully to the *bottom* of the tilted dish, and with a large soft camel-hair brush keep drawing up the developer as far as the sky-line, leaving the sky itself untouched. Occasionally let the developer cover the whole plate (sky and all) for a moment to prevent the sky getting too dry. By this means, negatives with very printable clouds may be obtained.

When the clouds in a negative have been completely blocked up by development, they may nearly always be recovered, by the judicious use of a reducer, carefully applied by means of a brush after the negative is dry.

119. *Graduated sky.*—When cloud negatives are not at hand, a graded sky may be readily printed in as follows: "Place the print on a flat board and cover it with a sheet of glass, or put it in the usual printing frame between two sheets of plain glass, lay over all a card or sheet of stiff brown paper, then expose it to a bright light, drawing down the card as far as the horizon line, keeping it constantly in motion up and down, giving most exposure to the top of the sky, which is always darkest in nature."

120. *Album for cloud prints.*—Theoretically, the same cloud should never be printed on more than one negative—many cloud negatives are therefore necessary. But comparatively few clouds are worth taking, and the

accumulation of a good stock is a work of time. Every cloud negative should be numbered, and a print of each, similarly numbered, pasted into a book for convenient reference.

121. **Water.**—It requires considerable experience to render *still* water satisfactorily in a photograph. If a bright light is reflected from the surface in the direction of the camera, the result in the picture will be a bare patch without the slightest detail. If, on the other hand, the light is insufficient, the shadows will be heavy. Fine effects may often be obtained, even when the water is quite still, by artificially disturbing it. The oars of a passing boat, or even clods of earth thrown in, produce very effective ripples.

Where large areas of water have to be dealt with the picture may be greatly improved by judiciously selecting the foreground, and so placing the camera that bushes or reeds, or similar objects, have the effect of breaking up the large expanse of water. Lowering the camera often greatly improves the picture.

Rapidly running water *must* have very quick exposure—see para. 110.

Running water in deeply-shaded glens is difficult to photograph owing to the excessive contrasts. The best plan is to use the largest stop the subject will admit of, and to give an exposure which, though *relatively* sufficient for the darker parts of the picture, is *actually* very short. This preserves some of the sparkle of the moving stream, whilst slow exposures only result in "wool."

122. For *glens* and *very shady places,* where running water forms no part of the subject, a diffused light and long exposure is to be preferred. In short, they are to be treated much like interiors.

123. **Snow scenes.**—Two subjects are usually coupled together as if they required practically the same treatment, viz., snow scenes and hoar-frost effects, but the experienced operator knows full well that the manner in which the one needs to be treated is quite different from that required by the other; and it is to the fact that this difference is so seldom realised that many failures are due.

The selection of suitable subjects for snow pictures is frequently one of considerable difficulty. The most delightful snow scenes with which I am acquainted are those which form the tailpieces to Bewick's "British Birds." These *appear* to show that but little is required to make an effective snow picture. In *his* hands a cottage with a bit of paling, or even an old hay-rick, forms, with the snow-covered landscape, a little gem which can be looked at over and over again with ever fresh interest. But though it all *looks* so simple when emanating from the hand of an able artist, the average photographer will find that unusual care is necessary in selecting his pictures. Rural scenes, old cottages and farmyards, are promising subjects; sheep and cattle taking shelter from the severity of the weather present a more difficult task, while skating "bits" are beset with unusual difficulties owing to the deficient actinic light of the winter's sky.

With regard to the choice of the view, the Rev. F. C. Lambert says: "Avoid a subject in which there is much dark material in the foreground, and equally avoid a subject which has no foreground at all. In this latter case we miss the feeling of space, distance, relief, open air, and full light.

Avoid also anything like reticulation of strong dark against light, *e.g.*, network of dark tree-trunks, palings, open woodwork, gates, etc. The effect of this is to irritate by a chessboard-like pattern of black and white patches. On the other hand, let your foreground be simple in form and subject—try to arrange for a small bit or patch of a dark object, and, if possible, let it be led up to by a series of less dark steps; at the same time, if you can bring your chief dark near to your prominent high light, you will thereby gain much by way of contrast. Moreover, let it be remembered that a large expanse of smooth, freshly-fallen snow does not yield a snow-like print, but usually a patch of white paper. Undulating ground is to be preferred to that which is quite flat, as yielding more gradation. Wind-drifts and their exquisitely transparent shadows are of immense value in expressing the luminosity of snow. Be cautious in selecting a roadway where the track shows as a string of black dots or maze of wheel lines. You are more likely to get a picture along the side than in the middle of the track, unless, of course, the snow be very deep and the tracks or markings are few, not confused, and without black patches."

A mere sprinkling of snow is not sufficient to ensure a characteristic picture—sufficient must have fallen to have obliterated most of the prominent features of the landscape, or a typical snow scene will not be obtained.

Again, as regards ice; one usually thinks of it as a bright, transparent, glass-like substance, capable of yielding a brilliant effect in the negative. And so doubtless it is when seen in thin layers on wayside pools, but, under ordinary circumstances, ice (especially when it has been much used by skaters, etc.) will be found to present a comparatively dull surface with a greenish tinge, and the result in the negative is not always what might be expected.

With snow on the ground all the uncovered parts of the landscape, especially the trees, seem to acquire an added blackness. Bright sunlight is not only often absent, but is even considered by some to be undesirable. I have, however, seen excellent snow pictures taken both with and without direct sunshine. The subject itself generally indicates which kind of light is most suitable.

And it must be always borne in mind that a large expanse of snow reflects so much light that the exposure actually *necessary* is considerably less than would be required for the same view if the snow were absent. During the winter the quality of the light varies so much from hour to hour that it is impossible to lay down *fixed* rules, but it will be found in practice that, in good diffused light, the time given *need not* be more than one-third or one-half of the usual exposure for the time of the year. Thus if the plates used require an exposure of (say) six seconds during the inter months, from two to three seconds will probably be found enough hen snow is on the ground, it being, of course, understood that this only olds good when the view is largely composed of snow, and when conse- ently the reflecting surface is considerable.

But though the time mentioned above is actually *sufficient*, the resulting gative will be somewhat hard. To prevent this, and to modify the excessive contrast always present in snow scenes, it is best to give a *full* exposure, and this is especially necessary when trunks of trees or other dark objects are in the foreground. The exposure should then be sufficient to define the markings on the trees and to give some details in the shadows, but the exposure, though full, should not be such as to produce what is called an "over-exposed" negative.

It should also be remembered that snow seldom lies long. When indications of a probable fall of snow appear, a programme of operations should therefore be at once decided on, views should be selected, and everything prepared for immediate work. In the winter the best light is usually in the morning; in the afternoon the atmosphere is generally too dull and heavy for satisfactory work.

Slow plates and a comparatively small stop should be used. Isochromatic plates, with or without the yellow screen, are an undoubted advantage.

124. The development of snow scenes requires to be very carefully managed to obtain the best results. "The problem is to get a long range of tone without weakness, and the most direct way is to aim at gradation first, trusting to getting sufficient vigour afterwards." If a *full* exposure has been given—as above recommended—the developer should contain about half the pyro and bromide prescribed for the full normal developer for the plates used, and only one-fourth of the alkali; this will bring out an image which, though weak, is very full of soft detail. After this has been attained, the exact reverse of the process must be adopted; the old developer, weak in pyro, should be thrown away, and one with a very full allowance of pyro and the normal amount of alkali and bromide poured on, and the development continued until sufficient density has been obtained. This will often take a long time, but trouble must not be grudged, and the result will be a negative which shows all the delicate gradation possessed even by white snow, with sufficient density to yield brilliant prints.

If a very full exposure has not been given, the normal developer, of half strength, will be found best to begin with, and it should be modified, if necessary, as development progresses, the secret of success being slow development.

125. **Hoar-frost.**—But whilst the snow scenes above described are examples of excessive contrast, hoar-frost subjects, which are usually trees or shrubs covered with rime, are precisely the opposite. In this latter case every twig is covered with its crystalline deposit, and the ground has usually its coating of snow. Everything is white, and there is no contrast. The difference in colour between the frost rime and the sky against which it usually shows is apparent enough to the eye, but is actually small in amount, and the difference is further diminished by the fact that the distant sky reflects comparatively more light than the nearer frost subjects. Contrary, therefore, to what was recommended in the case of snow scenes, everything must be done to *increase* contrast. The exposure must be as short as possible, not as a rule exceeding one-third or one-fourth the ordinary exposure for the time of the year, and the development must be carefully carried out.

The negatives of hoar-frost effects are apt to be somewhat disappointing. To the uncritical observer the frost rime is *so white* that he is surprised to find that in the finished negative it generally shows many shades darker than the sky. If, however, the view is intelligently and carefully looked at, whilst being focussed, it will be seen that only in very rare cases is the frost rime actually whiter than the sky, for much of the dark colour of the twigs *shows through* the rime, and the general tone will therefore be considerably darker than would be expected from a casual glance. It will also be seen that the rime lies thickest in the direction from which the fog originally drifted, and that on the opposite side the twigs are often quite bare and black.

It is only, therefore, when the subject is *in front of a dark background* that the full typical effect of frost rime can be attained in the negative. All this must be taken into account in selecting the point of view, and as frost rime is even more short-lived than snow, the necessity of taking immediate advantage of every opportunity is obvious: an hour of sunshine or breeze is sufficient to destroy the finest effects.

A good diffused light is most favourable, together with slow plates (preferably isochromatic), and a small stop.

In developing, everything should be done to increase contrast. Commence with the full allowance of pyro, sufficient bromide, and only half the alkali, adding the remainder by degrees if necessary. Full density, even approaching to hardness, should be got, and the negatives intensified if found necessary.

126. In very cold weather focussing is often rendered difficult owing to the condensation of the breath on the focussing screen. This may be remedied by smearing the outer surface of the ground glass with a slight trace of vaseline. The lens itself should also be looked to, and any signs of condensed moisture should be carefully removed, for the fogging of snow pictures is often attributable to a clouded lens.

127. Snow and frost scenes re uire to be suitably printed. Platinotype and bromide papers give excellent results, or gelatino-chloride paper toned to an engraving black, and finished with a mat surface. A snow print with any tinge of the usual photographic purple in it is unnatural.

128. In severe weather the moisture of the house is frequently condensed on the windows, and frozen in the most beautiful crystalline patterns. These are best photographed by placing a board, covered with black velvet or other dark material, at an angle of 45° outside the window. The camera is, of course, placed *inside* the window, and as this frost effect rapidly melts after the household fires are lighted, it needs to be photographed in the very early morning.

129. **Alpine scenes.**—Captain Abney, whose opinion is of the greatest weight in all photographic matters, says: "In photographing in the Alps, the colour values of the landscapes are often more correctly rendered as the light declines. In cases, for instance, in which a village close at hand forms the foreground, and five miles behind it is a background of mountains covered with snow, let the exposure be made in the middle of a sunshiny day, and the mountains will be nowhere in the picture under ordinary development, but let a longer exposure be given on the same subject

towards dusk, and a good photograph of the whole scene can be obtained"—see also para. 79.

130. The following extract from an address delivered by Mrs. E. Main, of St. Moritz, Switzerland, before the Photographic Congress at Chicago, 1893, is interesting. Speaking of "Winter Photography in the Alps," she says: "I would ask you to bear in mind exactly what snow is; that it is uniform in colour, almost smooth of surface, and on dull days without distinct outline against a grey sky. It must, therefore, be built up, so to speak, and modelled into that miracle of fairy delicacy and lightness which, under favourable conditions, it may become. We can have it at its best by working with suitable light at suitable hours. At mid-day in winter the light falls too directly on the subject; the lace-like tracery with its system of innumerable tiny snow crystals obtains no relief against the white robe, standing hard and stiff around rock and chalet. But go early in the morning or late in the afternoon and note the change. You will find in the long, soft shadows a thousand exquisite half-tones. See how the highest and nearer lights are broken, and broken again by the thin veil of surface crystals, each with its perfect modelling, its tiny shade throwing up its starlike form. Look at the rounded billowy flow of the snow where half in sunshine, half in shadow, it sweeps around and over the inequalities of the ground. If there has been a mist, however slight, during the night, a fretwork of hoar-frost will cover all, and will complete the materials for as fine a subject as you can wish for. You may find it desirable, by shovelling some of the snow, or trampling out a track, to break up any portion of the picture where the uniformity is too great.

"And now, having placed your subject under the most favourable conditions, what is the best way of photographing it? My own experience leads me to think that slow plates are by far the best, so that when used with a small stop the exposure can be as prolonged as possible. I give under the conditions of light just described an exposure of two seconds (with the smallest stop). In developing I am careful to work up the plate very slowly, and to carry the development very far, and when I have finished I expect to find a range of density from excessive blackness to clear glass; but though there must be no mistake about the quality of these two extremes, there must be very little of either. It is on the variety of the half-tones that the success of the picture depends, and it is for this reason that in photographing snow correctness of exposure is of such prior importance; and therefore a slow plate, allowing of more laxity in exposure than a rapid one, is far easier to work with. A plate under or over-exposed can never, however skilful the development, give a perfect result if the picture is of a snow-covered landscape, as the half-tones must suffer from the error.

"I have used the iron developer, eikonogen, and pyro and ammonia, and, for snow, have obtained the best results with the latter. I may add that when developing photographs of large moving figures, taken in winter in the Engadine, on our skating rink, I get the most successful pictures by allowing the plate to flash up at once under eikonogen, and continuing the development until the principal object is hardly visible when viewed by transmitted light.

"I should like to draw attention to the fact that very beautiful effects can be obtained in Alpine photography *by facing the camera to the sun,* which, of course, should be just *out* of the plate. For most subjects (water and clouds excepted) such lighting is rarely suitable, at any rate in so extreme a form, but with snow I have obtained most charming studies in this manner."

131. **Mountains.**—Mr. Burton points out that it is hopeless to expect a just rendering of mountains with a short-focus lens, and in no case should a lens of less than 12in. focus be used, because no pictures are likely to be looked at from a shorter distance than that, and if a mountain picture is looked at from a distance greater than the focal length of the lens with which it was taken, it is certain to look dwarfed. Small sizes are not suitable for mountain scenes, and if small plates are necessarily used the negatives should be made and developed with a view to enlargement. The ground glass and plate must be strictly vertical. If the camera is tipped without bringing the swing back into a vertical position, the mountain will appear to lean away from the camera. By leaning the ground glass forward the steepness of the mountain is increased, and though this is not legitimate it is often done.

The brightest light is not the best for mountain photographs; a moderate amount of haze is preferable. A little piece of foreground skilfully selected will have the effect of throwing the mountain further back. A sky shade is desirable, as the finest effects are often to be met when working directly against the light.

132. **Marine photography.**—A twin-lens hand camera is indispensable for marine work. Exposures should be made in the morning or afternoon, not at mid-day. The light reflected from a large expanse of sea is very brilliant, and the exposure will therefore need to be much less than on land. Sea work tries severely the wooden portions of the camera, which are liable to get out of order if not carefully watched.

In working on a ship or boat it is necessary to see that no stray rope or stanchion comes within the line of view—from their closeness to the camera they are much out of focus and hazy, and are very liable to be overlooked.

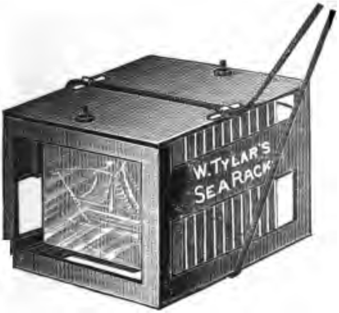


Fig. 5.

If development is carried out during the voyage the washing rack containing the negatives may be strongly attached to a line and lowered a few feet below the surface of the sea (provided the ship is not going too fast): after washing them for an hour they must have a final soak in fresh water. A rack for this purpose, designed by an officer serving abroad, and made by Mr. Tylar, is shown fig. 5.

Developing dishes of a special pattern are made for use on shipboard; the sides are turned over to prevent the spilling of the contents.

Sea-side views are often best photographed with the camera almost facing he sun, the lens being carefully shielded.

133. **Moonlight effects.**—The rigid artist will scarcely consider the usual way of obtaining moonlight effects by photography to be altogether legitimate. The method is to choose the afternoon or evening of a day in which the sky is plentifully strewn with clouds, to select a view in which the sea or other sheet of water is in the foreground or middle distance, and to place the camera facing the sun, carefully shading the lens. Patience must then be exercised until the sun is temporarily obscured by some of the clouds, so as to prevent its direct rays striking into the camera, whilst at the same time much bright light is reflected on the water from behind the cloud. Then considerably under-expose.

The moon may be indicated in the positive print by affixing a small wafer in a suitable position on the back of the negative, but this requires considerable judgment, or the effect is merely ludicrous.

Pictures recently taken and exhibited by Captain Abney show that actual photography by moonlight is not only possible, but that very good results can be obtained, and this with very much shorter exposures than have hitherto been considered necessary.

A CORNFIELD.

To avoid halation the plates should be backed. The subjects should be focussed by day.

134. **Trees.**—Photographs of single trees or shrubs are best taken in good diffused light, especially when they have shiny foliage like laurel or holly, from the smooth surfaces of which the bright sunlight is apt to be reflected, and to produce "snow and soot" effect. It sometimes happens that the special tree or shrub to be photographed is so closely surrounded by other foliage that in the resulting negative the selected object hardly stands out enough. When this is the case it is a good plan to work with as large a stop as possible—this puts the background slightly out of focus and throws up the principal object.

Cornfields and gorse hedges in bloom are very difficult subjects to render satisfactorily. Why it should be so is not quite clear. There is, of course, a large preponderance of yellow—the stubble, the shooks of grain, the gorse bloom, have all a distinctly yellow tint. An orthochromatic plate, a comparatively short exposure and prolonged development seem to answer best. A good dark background of trees or hills greatly improves the picture.

135. **Photographs of lightning.**—W. Marriott gives the following instructions:

(1.) The camera should be focussed during the day-time on some distant object, and a mark made on the camera, so that at night it may be quickly adjusted when a storm is approaching.

(2.) A rapid rectilinear lens with full aperture should be used.

(3.) The camera should be directed to the part of the sky where the lightning is most likely to occur.

(4.) The camera should be firmly screwed to the tripod stand.

(5.) It may be necessary to tilt the camera slightly, if the lightning be mostly in the zenith.

(6.) A portion of the landscape, roof, chimney-pot, etc., should, if possible, be included on the plate. If this cannot be done the top of the plate should be carefully marked before it is removed from the dark slide.

With a watch count the average time which elapses between the flashes, and take off the cap just before the next flash may be expected to occur; if the lens is opened somewhat too soon it will not matter if the night is dark. A watch with large "second" hand, such as is used for timing races, is very convenient, though not essential. Films are usually preferred to glass, but if the latter is used it should be "backed," to prevent halation. A pyro-soda developer is recommended.

136. **Photography by lamplight.**—Fig. 6 shows a good arrangement of lamps for photographing small objects at night. The light from the lamps must be so screened that none of it may enter the lens.

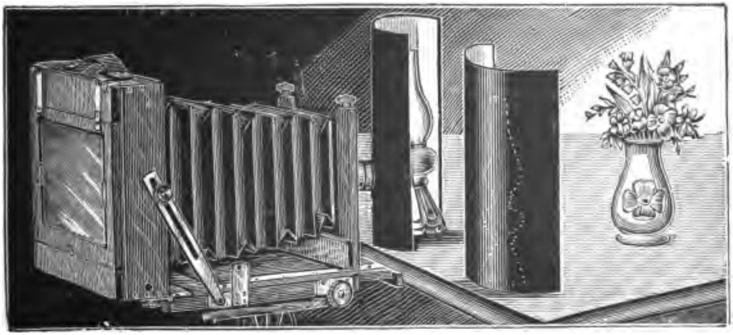


Fig. 6.

137. **Interiors.**—This somewhat difficult subject requires almost a treatise to itself. The briefest instructions are only possible here. As a rule, though

interiors are often dim enough, the main trouble is to shut out light coming from an objectionable source. "If possible let the main source of light come from *behind* the camera. If the camera must of necessity face the main source of light, such as the east window of a church with the morning sun streaming through, great halation is almost unavoidable. If such a window cannot be shaded, the evil may be lessened by working in the early afternoon, when the sun will have got round to the other (west) side of the church. In the case of house interiors, if the window most likely to cause halation is not the main source of light, close the curtains before exposure, and after sufficient exposure has been given, cap the lens, draw back the curtains, and give a very brief additional exposure, say, from half to two seconds. But if the window faces the observer the above plan is only partially applicable. The window must be completely covered up, the picture taken by magnesium light, the window being uncovered for, say, half-a-second at the end."

INTERIOR OF OLD MILL AT GORING.

"Wide-angled (rectilinear) lenses are generally necessary, but a lens of as long focus as possible should be used. Lenses of the portable symmetrical type are said to be less likely to give a flare spot, and to diminish halation." The lens should not be stopped down more than is necessary to get fair definition.

To shorten the time necessary for taking interiors it is recommended to commence exposure with a small stop, and to increase the size of the stop when the picture is partly exposed, but care must of course be taken not to move the camera when changing the stop.

The points of the tripod should be stood upon door mats, to prevent their slipping; or they may be shod with corks, or with special rubber shoes made for the purpose. As an additional precaution on very slippery floors, the legs may be prevented from opening out by tying pieces of twine from one to the other.

The camera must be accurately levelled, and the focussing screen absolutely vertical, otherwise the lines of the building will be out of perpendicular. Great care must be taken on this point, as the light is generally so dim that a little want of verticality is often unobserved unless specially looked for, and crooked lines ruin a picture.

Focussing is generally difficult, owing to the deficiency of light. A newspaper or white handkerchief held up at prominent parts of the building will be found a great assistance. For darker subjects, a lighted candle is better, but a few matches may be substituted on emergency. By lighting these at the extreme margins of the parts of the interior which it is desired to include, it will be seen whether these parts are shown on the focussing screen. Magnesium wire cannot, unfortunately, be burned for this purpose, because the smoke would interfere with the subsequent taking of the picture. Those portions of the interior nearest to the camera must be quite sharp, even though the distance be less distinct.

Thickly-coated plates should be used, and they should be "backed" to prevent halation. Films are considered to be less liable to halation than plates. In exposing, give plenty of time; some interiors require from five to six hundred times the normal exposure for an open landscape, say the difference between two seconds and twenty minutes, whilst some need hours. Perhaps the best general guide is the appearance of the image on the focussing screen, and its darkness or lightness, as compared with former successful exposures.

For photographing the inside of dark tunnels, coffer dams, caves, or similar subjects, the use of a suitable flash lamp, with pure magnesium powder, is imperative, or the magnesium powder may be placed on ordinary *metal* plates and lighted with a fusee. Magnesium ribbon, burnt in the focus of powerful reflectors, may be substituted when the flash light is not at hand, but it is not generally considered so effective. The light must, of course, be *behind* the camera, and where several are used, some should be placed within a foot or two of the floor, and others higher up towards the roof. Isochromatic plates, duly backed, have been found to give the best results with such subjects, combined with the fullest opening of the lens. As in other interiors, the focussing is the chief difficulty, and must be got over by the means recommended above.

Small interiors may also be photographed by ordinary lamp or gas light, the usual precautions being taken to prevent any of the light from shining into the camera; but with rooms of considerable size it is difficult to obtain an even illumination with lamps only. A full size stop, the most rapid plates, and a very full exposure will be found necessary.

138. *Stained glass windows* are difficult subjects from the fact that they are generally so high up that no amount of tilting the camera and using the swing back will suffice—some sort of raised platform is therefore frequently required. Unlike interiors, for which a diffused light is best, stained glass windows require the most brilliant illumination that can be had, short of sunlight shining straight into the window. Rapid isochromatic plates

suitably backed, and as large a stop as possible, should be used. A yellow screen is not generally desirable.

139. *Interiors of mines.*—Mr. J. C. Burrow has taken some very excellent photographs of the interiors of mines. He used a triple magnesium lamp of his own construction. Mr. Hughes has also taken very successful views in coal mines with the aid of a Platinotype Company's lamp, supplemented by an Optimus 1,000 candle-power lamp. Both worked, as a rule, with Zeiss lenses of Series III., but one great difficulty was to keep them free from condensed moisture. It is, of course, impossible to see much of the picture. The focussing must be done on candles placed at suitable points, and is much a matter of guesswork. The negatives take from two to three hours to develop, and always need to be intensified. The percentage of failures is necessarily large.

140. In developing interiors, a faint image should be first brought out with a weak diluted developer, the plate then washed and strengthened with a stronger developer. In extreme cases, where the contrasts are very great, a little strong developer may be applied to the more insensitive portions of the picture with a camel-hair " mop " brush, the ordinary developer being occasionally flowed over the whole plate to prevent stains.

To render the yellow flame of a fire visible on the negative, throw *salt* into the hottest part of the fire just before exposure; this makes the flame *blue.*

141. **Photographing animals.**—All animals are highly nervous, and anything like fuss or hurry should be avoided. Photographing animals taxes the operator's patience to the utmost, and he is fortunate if one negative in half-a-dozen is perfectly successful, but the result is well worth the trouble.

A Street Exhibition.

The chief difficulty arises from the fact that the animal to be photographed can seldom be confined to one spot, and that, as the distance between the camera and the object is seldom more than a few feet, any movement in the direction of, or away from, the lens throws the subject completely out of focus. *A camera with twin lenses*—to be held in the hand—is therefore the *only efficient* arrangement. To attempt such work with a stand camera would only lead to endless worry and ultimate failure. This twin-lens camera *may be* specially made to take plates of any required size, but practically an ordinary quarter-plate camera, with a pair of 6in. lenses, will be found to give quite as good results as a larger plate if the pictures are subsequently enlarged. This is therefore the ideal apparatus for this kind of work. Only very small percentages of the negatives of animals are likely to prove perfect in every respect, and consequently numerous plates have generally to be exposed on each subject, so that the negative possessing the best pose may be selected, and the remainder set aside. The small plate has therefore a great economical advantage over one of larger size.

Backgrounds for animal pictures.—A great many animal pictures are spoiled by unsuitable backgrounds. The object should, of course, be to get one as *unobtrusive* as possible, whilst at the same time its colour should afford a *moderate contrast* to that of the animal to be pictured. Bearing this in mind, the selection of *natural* backgrounds must be left to individual taste, and to the facilities available. Stable doors or buildings with straight lines should be scrupulously avoided, for the hand camera will frequently be more or less tilted, and the lines would therefore be out of perpendicular.

When an *artificial* background is provided, care should be taken that it is long enough to cover the whole of the negative, after allowing sufficient margin for any movement of the animal after it has been got into position. It should also be seen that it is not only high enough to cover the plate, but that the lower edge comes *quite to the ground*, and the picture will be improved if the juncture between the background ond the ground itself can be slightly hidden by a few wisps of straw naturally thrown down, or anything of this sort.

As regards material for the background, the coarse brown paper, six or more feet in width, which is often laid under carpets, answers well, and is of a nice neutral colour.

If the animal is small, such as a kitten, a few rough hampers may be piled one on the other to make a stage about the height at which the camera is held, and this has the additional advantage of restricting the movement of the subject within certain limits.

Large animals must be coaxed to move to a spot previously selected, but it will be found that what is wanted far more than any special advice is *patience.*

Captain Hayes recommends that horses should be photographed away om their usual surroundings, for when a horse is in a strange place "he is ll of curiosity and alertness, a condition which is the most suitable for btaining an animated portrait of him."

Herr Anschütz and Mr. Wallace both recommend that animals be photoraphed in full sunshine, but when this is done, unusual care is required to avoid harsh shadows. I myself prefer *good diffused light,* with the fastest possible plates, and the longest possible exposure.

At certain hours of the day most animals leave off feeding, and become sluggish and drowsy; this time is the photographer's opportunity. A low whistle will often bring the ears forward into a natural position.

The attitude to be selected must depend on the purpose for which the picture is required. Horses or prize stock are generally photographed to show their "points," and for this purpose a side profile view is generally the best, but the endeavour should be made to take advantage of a position in which all four legs and tail are visible. For artistic purposes, any position is serviceable, except, perhaps, one in which the animal directly faces the camera, where the resulting foreshortening unless redeemed by very special advantages of light, is apt to cause the picture to appear distorted.

142. **Home portraiture.**—Likeness-taking is better left to the professional photographer, who has all the special appliances for the purpose, but if the amateur *will* take up this subject, the following hints may be useful. Above all things, he must be most careful to select *suitable and unobtrusive backgrounds:*

Indoor work in an ordinary room.

The sitter must not be placed immediately facing the window, but rather behind and at an angle with it. The camera should not be much above the level of the face of the sitter.

When the hangings of the room itself cannot supply any suitable light-coloured background, a length of unbleached sheeting or of grey flannel, either stretched on a frame or hung on the wall, will be found very suitable.

Extempore reflectors may be made by laying a white sheet over a tall clothes horse.

If the pattern of the carpet is too pronounced, lay over it a plain rug or blanket of quiet colour.

A looking glass placed at a proper height at one side of the camera serves to fix the direction of the eyes.

It is a good plan first to practise on a plaster cast until by the adjustment of the light and the reflectors a pleasant result is attained. A dozen quarter-plates are well expended on these trials, and save much subsequent disappointment.

Outdoor work.

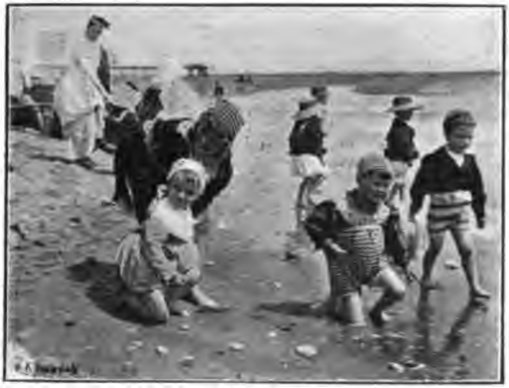
Choose a natural background, if possible, and let it be one in an even plane and not too far back, so that, though it must necessarily be out of focus when using a large stop, it is not too glaringly blurred. If a natural background is not available, an artificial one must be used. The sitter must not be in direct sunlight, and must, if possible, be placed to face a dark object, so as to avoid glare in the eyes.

Groups.

In the taking of a group the chances of failure increase in geometrical proportion for every additional person in it. A group should not be taken in direct sunlight. Everything should, as far as possible, be arranged beforehand. The best position should be selected, an object in the centre of the spot which the group will occupy should be carefully focussed, and only after all this is done should the final arrangement of the group be attempted. Nothing can be well more hideous than a straight row of figures all staring into the camera, but come upon the same party unexpectedly when taking afternoon tea in the garden, secure the picture with a twin lens hand camera, and the result will be very different.

Children must be taken in the open air with very rapid exposure A twin-lens hand camera is absolutely essential. The aim should be to make *pictures,* as well as likenesses.

Let the children play about, follow them carefully and unobtrusively, focussing all the time, and when a picturesque attitude is seen, discharge the shutter. Mr. Gee points out that babies and very young children may be made to look in the direction required by lighting a fusee and holding it up in a suitable position.



ON RAMSGATE SANDS.

By reflection in a mirror.—Excellent portraits can be taken in any ordinary room by reflection in a looking glass. The sitter is placed in front of a window, and a mirror (which should be of a good *plate* glass) is stood on the window-sill or on a small table, with its back to the light, and on a level with the sitter, who then looks at himself in this and arranges his attitude (see fig. 7). If the camera were now to be placed behind the sitter its image would be reflected in the glass, and appear in the negative. To obviate this, the mirror is turned *at a slight angle,* and the camera fixed *at the opposite side* (see fig. 8); its reflection will not now appear on the focussing screen, and the sitter will not see his own face in the mirror, but only the reflection of the camera. I first saw this plan described in an article in the *British Journal of Photography.* With rapid plates, an aperture of f/11, and a good light, an excellent picture may be taken in an ordinary room in from one to two seconds.

143. **Figures.**—But whilst mere portraiture is the province of the professional photographer, there is no more interesting branch of photography than "genre" pictures or "figure studies." An artist's eye, unlimited patience, and considerable skill are essential to proficiency, and the happy knack of putting the subjects at their ease is quite half the battle. Here, again, a twin-lens hand camera is invaluable, the small pictures being subsequently enlarged, or printed as lantern slides.

But, with many subjects, and especially those indifferently lighted, where the exposure cannot therefore be instantaneous, the stand camera must of necessity be used. The picture must be composed, and the figures suitably grouped. It is always best to explain to the subjects the effect that it is desired to produce, and they will often arrange themselves in natural attitudes, especially if the attention is somewhat diverted by conversation; risk several failures rather than produce constrained positions by too many cautions against moving. The feint of uncapping and capping the lens will often put the sitters at their ease for what they consider a second, though it is in reality the first, exposure.

The morning and evening light is the best for figure subjects, and a bright diffused light is far preferable to direct sunlight. The aperture must be as large as is consistent with good definition. In many subjects the background is quite subordinate, and may be considerably out of focus without detriment to the picture, but where the surroundings form part of the subject the definition over all must be fairly good.

144. **Photographing flowers.**—Mr. John Edmonds, who has had considerable experience in this branch of the art, furnishes the following instructions: "Flowers look most natural when, either singly or in sprays, or as a group, they are shown upon a dark ground. I use a piece of dark velvet laid upon a board and tilted up to any convenient angle. If two boards are hinged together, the upper one may be raised or lowered at will, and kept in position by a slotted rod fixed by a screw. A similar jointed board is fixed to the top of the tripod, and is made of the same size as the baseboard of the camera, with a similar arrangement for raising and lowering. This enables the object and the sensitive plate to be brought into the same plane. The light of a summer evening is best for flowers—yellow ones especially." When flowers are thus laid on a *sloping* board they retain their natural curves, which is not the case when they are placed against an *upright* board, to which they must necessarily be pinned or otherwise fastened. A sheet of fine wire gauze fixed to a light frame makes a very suitable background, as to it the sprays may be loosely tied in a natural manner.

Orthochromatic plates are generally used to obtain the best effects; with these the yellow screen is unnecessary. Excellent results can be obtained with ordinary plates, the yellow screen being used. But a most successful photographer of flowers, Mr. H. Stevens, uses neither orthochromatic plates nor colour screen, and trusts to obtaining his effects by lighting only, coupled of course with judicious development.

The light should make an angle of about 45° with the axis of the lens and the plane of the ground glass. A dark background is generally preferred, especially for white flowers.

Flowers may be also photographed out of doors by selecting a quiet spot facing north, and protected from sunlight. By using a muslin screen overhead to cut off too much top light and a standing reflector on *one* side, fair pictures may be made, but they will seldom be so good as those taken in the studio.

As flowers are necessarily photographed from a comparatively short distance, the group should be in a reasonably flat plane, and care should be taken that no stray flower or leaf projects unduly in the direction of the camera, as such portion would, of course, be exaggerated and blurred.

Tall flowering plants with conspicuous foliage, like foxglove or the giant hemlock, are preferably photographed *in situ*, the camera being kept rather low, and a good light chosen.

145. **Photographing pictures, etc.**—*By daylight.*—Oil pictures should be fixed vertically in a light so arranged that there are no injurious reflections from their glazed surfaces, and especially from the little irregularities caused by the coarseness with which the paint is laid on.

Many professional photographers cut off all front light, and work with side and top light, or even with top light only.

Others, like Mr. John Carbutt and Mr. E. J. Wall, prefer to copy pictures in *direct sunlight*, and the latter considers the next best light to be that of magnesium, then gaslight, and, lastly, diffused daylight.

When oil or water-colour pictures and similar difficult subjects are photographed by *daylight*, a yellow screen, in addition to an orthochromatic plate, is necessary. Screens of several depths of tint should be provided,

CARRYING CORN.

d by focussing the picture through the screen it will be seen which tint nders the picture in its truest "values." A water-colour picture or an l picture painted in a light scheme of colour will probably go best with e lightest tint, whilst an oil-painting may require the deepest tint ailable.

By artificial light.—But as it is exceedingly difficult to avoid reflections when working by daylight, gas or oil-light is often preferred. The arrangement shown in para. 136 is generally suitable, but the lamps should be kept as far back from the picture as can be done without too great loss of light, and a long-focus rectilinear lens used. As the exposure will be long, the lens must be worked at a comparatively large aperture, and should therefore be powerful enough to cover the plate sharply to the margins. Colour-sensitive plates are specially suited for this purpose, not only because they render colours truer, but because they are much more rapid by lamplight than ordinary plates. With these the yellow screen is not necessary, but if ordinary plates are used the yellow screen is desirable even by lamplight.

Oil and water-colour paintings will be found to require very different exposures. By daylight the time will be roughly as 6 to 1 for oil and water-colours respectively, and by lamplight probably as much as 60 to 1.

Except in the case of pictures of very large size, the amateur will often find that artificial light gives him better results than daylight.

Photographs on albumenised or gelatine paper may be copied on ordinary plates, with the same precautions against reflected light.

Mr. Wallace recommends that the photograph be soaked in warm water, and detached from its mount. While still in the water a piece of thin plate glass is passed under it, and the two brought out together. After seeing that there are no air bubbles, the face of the plate is wiped, and the print immediately photographed before it becomes dry. Or it may be regularly mounted on glass like an opaline.

Platinotypes, bromides, and other mat surface prints are treated like engravings—which see below.

It is possible to make a very good negative *from the print itself.* It is placed, face upwards, in a printing-frame with a glass front, and a sensitive plate put on it, and exposed to gas or lamplight. A weak developer should be used. A negative may even be made in the same way by using a bit of sensitive paper instead of a plate, and the paper negative thus made may be used for printing positives.

Engravings should be pinned to a vertical board, and when working by daylight a black cloth should be laid over two rods extending from the top of the camera to within a foot of the engraving, so as to exclude extraneous light from the lens. Some cover the whole space between the camera and the picture with thin tissue paper, and this is considered the best plan to prevent the grain of the engraving from appearing on the negative.

If gas or lamplight is used, the arrangement shown at para. 136 is convenient.

The best plates for the purpose are photo-mechanical or dry collodion—they should be slow. The lens should be fully capable of covering the plate sharply to the margin, but should not be larger than is necessary to do this, for, as pointed out by Mr. Armstrong in some excellent articles on this subject in the *B.J.P.*, a lens that considerably more than covers the size of the plate is liable to convey light to the sides of the camera and to produce haze on the negative. A small stop should be used.

The exposure should be sufficient, for with an undertimed plate it is difficult to get density.

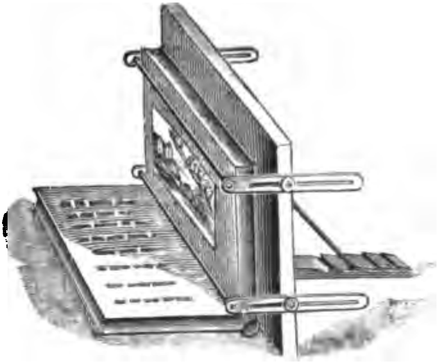


Fig. 9.

The development must be most carefully carried out. Pyro-soda is generally preferred (though glycin is said to be suitable for this kind of work). The developer should be very strong in pyro, and sufficient bromide must be added to prevent the risk of a trace of fog. Development must be stopped before there is the slightest deposit on the clear parts of the negative; it is rarely possible to get sufficient density by development alone, and the negatives must be subsequently intensified. When the development is complete, Mr. Armstrong recommends that without previous washing the plate be first rinsed with a clearing solution containing two drams of strong acetic acid to the pint of water, and then (again without washing) be put into a bath of the same clearing solution for some minutes. Then wash *thoroughly*, and fix in *freshly mixed* hypo. Again wash (but do not alum) before intensifying, for which mercury and cyanide of silver is recommended.

When copying engravings from books a special apparatus for keeping the page flat is required—see fig. 9.

146. In copying of every sort care should be taken that the camera and dark back are accurately levelled, that the planes of the object and of the sensitive plate are exactly parallel, and that the lens points to the centre of the picture. A rapid rectilinear lens with small stop should be used for all copying work.

147. **Photographing coins, etc.**—These are not photographed direct, but from casts made in plaster of Paris, coloured with a little brown umber to deaden the excessive whiteness of the plaster. The colour may be graduated to represent the metal of which the coins are made, the lightest tint representing silver, a medium colour answering for gold, and a comparatively dark colour for bronze or copper coins.

148. **Photographing works of art.**—Articles with highly-burnished surfaces cannot be satisfactorily photographed until the reflections have been first dulled. In the case of hollow articles, like silver bowls or vases, a simple plan is to fill them with water, and immerse in it a lump of ice

immediately before the exposure is to be made. If the room is fairly warm and moist, moisture rapidly condenses on the outer surface, and the obnoxious reflections vanish. Articles which are not hollow can be immersed in iced water, then rapidly wiped, and photographed before the condensed moisture evaporates. Or they may be dabbed over with a lump of soft putty. But where this cannot be done, and where the articles must be photographed with their polished surfaces intact, all front light, as well as the light from one side, should be cut off, and the light from the remaining side only used.

149. **Photographing machinery, etc.**—Bright machinery may be painted with slate-colour flatting, or with a mixture of milk and carbonate of magnesia. Front light should be excluded, and a suitable background provided, but if this is not possible, and it is wished to do away with the ordinary workshop background, prepare an untoned and fixed print, cut out the machinery portion, and paste the mask thus made on the back of the negative, taking care that it registers accurately.

Monumental brasses, when possessing highly-polished surfaces, should be rolled over with a lump of putty, which may be afterwards removed with paraffin oil.

CHAPTER VI.—DEVELOPERS.

150. Practical development is treated of in the next chapter, the relative qualities of the several developers generally used will here be considered. They are as follow:

	The ferrous oxalate developer.
	The pyrogallic developer.
The aniline or coal tar series.	Quinol (hydroquinone).
	Eikonogen.
	Amidol.
	Rodinal.
	Metol.
	Glycin.

The inordinate multiplication of developing formula is a great evil. It will be seen, therefore, that, instead of increasing the present overwhelming number of recipes, I have quoted, as a rule, the formulæ of well-known plate makers—see para. 181.

151. **Ferrous-oxalate developer.**—This developer, although still employed on the Continent, is not much used in this country, except for developing bromide paper (which see), and occasionally also for lantern slides. In the hands of French photographers, it produces excellent results.

For those who care to experiment with this developer, I give Cadett and Neall's formula:

No. 1.—Ferrous oxalate developer.

A.		B.	
Ferrous sulphate (proto sulphate of iron)	2½ ounces.	Potassium oxalate neutral	10 ounces.
Sulphuric acid	5 minims.	Hot distilled water to make	40 „
Distilled water to make	10 ounces.		

The ferrous sulphate should be powdered just before solution in about three-quarters of the distilled water to which the sulphuric acid has been previously added. Make up to bulk after solution.

Dissolve the potassium oxalate in about three-quarters of the distilled water, made warm, and make up the bulk after the salt is dissolved.

For use.—Add one part of A to four parts of B (not *vice versâ).* For over-exposure, add to the mixed developer a few drops of a ten per cent. olution of potassium bromide. Negatives require to be very fully eveloped, or the images will be weak, and are preferably fixed in a bath omposed of hypo 5 ounces, chrome alum 1 ounce, water 40 ounces. This olution is green in colour, and is considered to improve the printing quality f the negative. The same solution will develop more than one plate.

152. **Pyro-ammonia developer.**—Notwithstanding its many rivals, the pyrogallic developer is the most generally used for all purposes in England. Its great advantage is that its component parts may be modified almost indefinitely to suit variations from absolutely correct exposure, and, in spite of much that has lately been written on the subject, there is but little doubt in the minds of many practical photographers that the modification of the developer *does* materially influence the quality of the negative. *The stock solution keeps for a long time if protected from light in a stoppered bottle.*

The varieties of formulæ for the pyrogallic developer are endless; the preservative used is either sulphite of soda, metabisulphite of potash, nitric, citric, or sulphuric acids or glycerine, but the sulphite of soda, neutralised with an acid, is the one most generally used. The alkali is either ammonia, carbonate, or hydrate of soda or potash, or a mixture of soda and potash.

The restrainer generally used is bromide of potash or bromide of ammonium.

Workers will do well to use the formula to which they are accustomed, but an ordinary formula suited for most purposes is here given—it will be noted that they are all (approximately) ten per cent. stock solutions, and that, therefore, every ten drops of each solution contain one grain or one minim of the active ingredient.

No. 2.—Pyro-ammonia developer.

A.

*Pyrogallic acid ...	1	ounce.
Soda sulphite	2½	ounces.
Citric acid	120	grains.
Distilled water to ...	10	ounces.

B.

Liquor ammonia ·880 ...	1	ounce.
Distilled water to	10	ounces.

C.

Ammonium bromide ...	1	ounce.
Distilled water to	10	ounces

For use.—Take twenty drops of A, twenty drops of B, three drops of C, and fill up to one ounce with water. Each ounce of developer will, therefore, contain two grains pyro, two minims of ammonia, and about one-third of a grain of bromide.

153. **Pyro-soda developer.**—But though the old pyro-ammonia developer is still largely used, it has with many workers been replaced by pyro-soda.

There are numerous formulæ very much alike, and differing chiefly in the nature of the preservative used. Paget's formula is as good as any, and is here given:

No. 3.—Pyro-soda developer.

A.

Pyrogallic acid	¼	ounce.
Sulphuric acid	5	drops.
Distilled water to make	20	ounces.

B.

Soda carbonate	2	ounces.
Soda sulphite	2	,,
Distilled water to make ...	20	,,

For use.—Take equal parts of A and B, and in cases of over-exposure add from three to ten drops of a ten per cent. solution of potassium bromide.

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* Pyro and many other chemicals are sold by avoirdupois weight = 437½ grains to the ounce, and in the formulæ these ounces are meant, but where *grains* are mentioned they are *Troy* grains, of which 480 = 1 ounce. But in calculating the component parts of each developer the ounce has been taken uniformly at 480 grains—minute fractions are thus avoided, and the difference is practically immaterial.

Each ounce of this developer contains three grains of pyro, twenty-four grains of sodium carbonate, and twenty-four grains of sodium sulphite.

154. By many workers potassium metabisulphite is preferred as a preservative to nitric, sulphuric, or citric acids. B. J. Edwards's formula is therefore given:

No. 4 — Pyro-soda developer with metabisulphite.

A.	
Pyrogallic acid	1 ounce.
Metabisulphite of soda...	1 „
Water	80 ounces.

Dissolve the metabisulphite, and then add the pyro.

B.	
Soda carbonate	12 ounces.
Soda sulphite	4 „
Water	80 „

For use.—Mix equal parts of A and B, and in cases of over-exposure add from three to ten drops of a ten per cent. solution of potassium bromide. Each ounce of this developer contains three grains of pyro, three grains of metabisulphite, twelve grains of soda sulphite, and thirty-six grains of soda carbonate.

155. Pyro-potash developers seem to have fallen out of use, though carbonate of potash is still used with the aniline developers. A good pyro-potash developer may be made by substituting potash carbonate six ounces for soda carbonate twelve ounces in the above developer No. 4.

156. **Developers derived from aniline products.**—These comprise hydroquinone (quinol), eikonogen, amidol, rodinal, metol, glycin, and some others not in general use. Some of these are one-solution developers, that is, when they are mixed with the sodium sulphite preservative they will develop a plate without the addition of an alkali; rodinal diluted with water will develop without other addition.

Quinol and metol keep well in solution; eikonogen only for a short time; amidol will not keep.

Temperature has the same effect on these developers as on pyro; a low temperature slows the action, and great cold almost stops it. On the other hand, excessive heat tends to fog.

Negatives treated with most of these developers lose considerably in fixing.

157. Most of the coal tar series of developers may be used for several plates, but this practice should not be pushed too far, and the general statement that these forms of developer may be used over and over again indefinitely is misleading, and apt to cause disappointment, and also to stain the plate a yellow colour owing to the oxidisation of the sulphite. Eikonogen used without sulphite stains the negative a yellow colour, and the same stain is produced by using the developer over and over again; the sulph*i*te is transformed into sulph*a*te, which is a retarder of development, but not an absorber of oxygen, and does not preserve the eikonogen or quinol as does sulphite.

158. Each of these developers has its peculiarities, which may be briefly summarised here. They are described in more detail further on.

Quinol tends to give rather strong contrasts, and is not therefore so often used for ordinary landscape work, except when mixed with eikonogen, but is good for many subjects, especially for black and white work and for lantern slides.

Eikonogen gives great softness, but with it sufficient density is not sometimes readily obtainable.

Amidol is a better all-round developer than either of the above. It evolves much detail without clogging the high lights. It is also good for lantern slides and bromide paper.

Metol is perhaps the best of the series; it is energetic in action, neither fogs nor stains, and keeps well in solution.

Rodinal is a solution of paramidophenol.

Glycin gives hard results, and is only suitable for black and white work, such as copying engravings, etc.

159. **Quinol developer.**—On its first introduction much was claimed for hydroquinone (or quinol, as it is now usually called). Longer experience has shown that it is not likely to supersede pyro, though it possesses qualities which make it preferable for certain purposes, more especially for lantern slides and transparencies. When used for ordinary landscape work it is generally found to give a harder negative than pyro, and though the normal proportion of alkali may be increased or diminished, quinol does not seem to lend itself to the almost indefinite modification which is possible with the pyro developer. *Quinol keeps fairly well in solution.* It is generally recognised that the hydrates of soda and potash are the best alkalies for use with quinol. For ordinary work, Ilford's formula is excellent, and is as follows:

No. 5.—Quinol developer.

A.		B.	
Quinol	160 grains	Sodium hydrate	100 grains.
Sodium sulphite... ...	2 ounces.	Water to	20 ounces.
Potassium bromide ...	30 grains.		
Hot water to	20 ounces.		

First dissolve the quinol thoroughly, and then add the sulphite and bromide.

For use.—Take equal parts of A and B, and in cases of over-exposure add a few drops of a ten per cent. solution of bromide of potassium. Each ounce of this developer contains four grains of quinol, two and a half grains of soda hydrate, twenty-four grains of soda sulphite, and three-quarters of a grain of potassium bromide.

Bromide of potash has very little restraining effect when used with hydroquinone (quinol). For over-exposed plates, the quinol developer may be diluted with water, or five or six grains of bromide of potash may be added to each ounce of the developer thus diluted.

In the case of apparent under-exposure, the quinol developer may be replaced by an eikonogen, metol, amidol, or other developer of this class, which gives a more transparent image in the high lights than either quinol or pyro.

160. **Eikonogen developer.**—Whilst quinol is credited with producing a somewhat hard negative, it is claimed for eikonogen, and other developers of the tar derivatives, that they educe more detail than quinol, though negatives developed with eikonogen are sometimes apt to want density. The

formula shows the proportions considered best for general purposes. *Eikonogen keeps fairly well in solution*, but it is better to make up only sufficient to last for a week. The following is Mawson's formula:

No. 6.—Eikonogen developer.

A.		B.	
Eikonogen	150 grains.	Potassium carbonate ...	1200 grains.
Soda sulphite	150 "	Soda sulphite	500 "
Hot water to	15 ounces.	Water to	10 ounces.

For use.—Take three parts of A and one part of B, mixed at the time of developing, and add one-fifth of a grain of bromide of potassium. Each ounce of the above developer contains seven and a half grains of eikonogen, twenty grains of soda sulphite, thirty grains of potassium carbonate, and one-fifth of a grain of bromide.

If, after developing with eikonogen, all the detail is out, but the density is still insufficient, the image may be strengthened by pouring off the eikonogen developer and replacing it by the quinol formula, No. 5; but if it is preferred to strengthen the image with pyro and ammonia, the plate must be *well* washed before applying it. Six grains of "eiko" in each ounce of developer is enough for ordinary purposes, and will generally give as much density as will be found necessary.

The addition of the usual quantity of bromide to the developer is not advocated, as even one-fifth of a grain of bromide of potash has a marked effect as a restrainer, but the addition of this one-fifth of a grain is beneficial, as it tends to keep the shadows clear, especially when large quantities of carbonate of soda or potash are used, and tends to give density.

Ammonia should not be added to the eikonogen developer in any shape, as it has a tendency to decompose the solution and stain the negative.

161. **Amidol** is a salt of diamidophenol. It is sold in two forms, viz., an oxalate (amidol-Hauff) and a chloro-hydrate (amidol-Andresen).

Amidol-Hauff is sparingly soluble in water, but dissolves more readily in a solution of sodium sulphite. *It does not keep well in solution.*

Bromide up to one grain per ounce has but little effect on the amidol developer—more than this slows development considerably. Dr. Eder says that very considerable over-exposures cannot well be corrected by the addition of bromide to amidol (and metol), nor may this be successfully done by the employment of an old, repeatedly-used developer.

Amidol is used in two ways, viz., as a one-solution developer or as a two-solution developer in combination with a fixed alkali. The makers' formulæ are as follow:

No. 7.—Amidol one-solution developer.

Amidol	60 grains.	*For use.*—Mix one ounce of this stock solution with three ounces of water, and add a few drops of a ten per cent. solution of potassium bromide.
Sodium sulphite	1½ ounces.	
Water	7 "	

As amidol, when dissolved, rapidly loses its developing power, it is preferable, for occasional work, to keep only the sulphite in solution, and to add the dry amidol when the developer is about to be used.

No. 8.—Dry amidol developer.

Sodium sulphite	1 ounce.	Add two grains dry amidol, and a few drops of potassium bromide to each ounce of the sulphite solution.
Water	20 ounces.	

To retard development in the case of over-exposure, largely increase bromide, using in extreme cases even up to one-quarter bulk of the amidol solution, and to accelerate it add twenty per cent. solution of sodium sulphite, as required. On very hot days, add a few drops of a ten per cent. solution of citric acid.

No. 9.—Amidol developer.

A.		B.	
Amidol	1 ounce.	Soda carbonate	2 ounces.
Potassium metabisulphite	2 ounces.	Water	20 „
Water	20 „		

For use.—Take of A ten parts, of B from six to ten parts, bromide solution (ten per cent.) three parts, water seventy parts; each ounce of this developer will then contain two and two-third grains of amidol, five and one-third grains of metabisulphite, and five and one-third grains of soda carbonate, and a trace of bromide. *Or*, for softer image, A ten parts, B twenty to forty parts, bromide solution (ten per cent.) half to three-quarter part, water seventy parts.

"Amidol developers may be used four or five times without much loss of power, but they will not keep long."

Amidol negatives lose considerably in fixing; they should therefore be developed to sufficient intensity.

162. **Metol** is to be had in two forms, viz., an oxalate (metol-Hauff) and a sulphate (metol-Andresen). It is soluble in water to the extent of two and a half per cent., and much more liberally in a solution of sodium sulphite. It *keeps unchanged for a considerable time*, and may be used over and over again within reasonable limits. Bromide in small quantities has but little action on metol.

No. 10.—Metol developer.

A.		B.	
Metol	150 grains.	Potassium carbonate	1 ounce.
Water	30 ounces.	*Or*, Sodium carbonate	2 ounces.
When dissolved add		Water	10 „
Sodium sulphite	3 ounces.		

The metol must be dissolved *before* the sulphite is added.

For use.—Take three parts of A and one of B, and to each ounce of this mixture add forty minims of a ten per cent. solution of potassium bromide. For snap exposures omit the bromide, and for over-exposures add up to one dram of bromide. It is best, in order to rectify possible errors of exposure, not to add the solution B all at once, and to begin with a smaller quantity. For strong and *over-exposures*, solution A by itself will probably suffice for the complete development of the image. Mistakes in exposure may also be guarded against by using an old developer, and the oftener this has been used the clearer and harder it works. Plates which gain density with difficulty may be worked with equal parts of A and B solutions and a considerable quantity of bromide.—*Maker's Instructions.*

For under-exposure.—Three parts of A, half-part B or less, water half-part, no bromide. When the detail is all out, pour away this developer, and replace it with the ordinary formula to get density. When soda is substituted for potash in solution B of the above formula, the addition of bromide is not so necessary, but it may be found that, with either soda or potash in a very weak developer, surface fog is liable to appear without the addition of about a quarter of a grain of potassium bromide.

Should the negative be found to be very much over-exposed, it is a good plan to remove the developer and pour over the film sufficient of solution A, diluted with twice the volume of water and one or two grains bromide to the ounce of dilute developer, but *without any addition of alkali*, and after this has acted for some time, to add very cautiously a small quantity of solution B.

Metol is of great value for developing plates which have had minimum exposures. When such plates are developed with pyro, the high lights take on great density, while the half-tones lag far behind, and the result is a harsh negative, but with metol the balance is better kept. The half-tones attract their fair share of the deposit, whilst the high lights do not get too dense, and hence a far softer and more printable negative results. A metol developer is, therefore, particularly valuable for short exposures, such as a large proportion of hand-camera work.

It must, however, be remembered that the *printing* density of a metol-developed negative is considerably less than the *apparent* density, and this applies specially to negatives required for printing in platinum.

163. Complaints have been made of the injurious action of metol on the skin of some operators whilst others are unaffected by it. But if ordinary precautions are used, even the most sensitive skins need not be affected. If, for instance, when it is wished to examine the negative under development, the developer is first poured back into the developing glass, and *the negative well washed;* it may then be handled with absolute impunity.

164. **Paramidophenol developer.**—Dr. Bach recommends the following.—*P.N.*, 31st July, 1896.

No. 11.—Paramidophenol developer.

A.		B.	
Paramidophenol hydrochlorate...	200 grains.	Potassium carbonate ...	3000 grains.
Potassium metabisulphite	20 „	Sodium sulphite	1200 „
Water distilled	20 ounces.	Water distilled	40 ounces.

For use.—Mix one part of A with two parts of B and add about ten drops of a ten per cent. bromide per ounce.

Rodinal is a compound developer, sold in liquid form. It is said to be a ten per cent. solution of *paramidophenol* with metabisulphite and caustic oda. The solution (as sold) is to be diluted with about thirty parts of ater for ordinary negatives, and forty-five parts for lantern slides. *It will ot keep long after dilution.*

Thomas's *Cyclol* developer is said to be composed of rodinal 9 drams, uinol 30 grains, eikonogen 100 grains, sulphite of soda 2½ ounces, carbonate f potash 2½ ounces, water 20 ounces. It is diluted with seven parts of ater in summer, and three in winter.

165. **Glycin** is very slow in action, *and does not keep in solution.* It yields rather harsh negatives, and is therefore best suited for developing negatives of engravings, maps, etc. The formula given by the makers for soft negatives is as follows:

No. 12.—Glycin developer.

A.	
Glycin	1 ounce.
Potash carbonate	¾ ,,
Sodium sulphite	3 ounces.
Water	25 ,,
Warm slightly.	

B.	
Carbonate of potash	2½ ounces.
Water	25 ,,

For use.—One part of A is mixed with two parts of B. Negatives lose much in fixing.

MIXED DEVELOPERS.

166. **Mixed quinol and eikonogen developer.**—A mixture of quinol and eikonogen makes a developer which is considered to combine the density-giving property of the former with the detail-producing quality of the latter. Paget's formula for this developer is as follows:

No. 13.—Quinol eikonogen developer.

A.	
Quinol	60 grains.
Eikonogen	½ ounce.
Sodium sulphite	1½ ounces.
Potassium bromide	8 grains.
Water to	30 ounces.

B.	
Potassium carbonate	1 ounce.
Or, Sodium carbonate	2 ounces.
Water to	10 ,,

For use.—Take three parts of A and one part of B, and add four drops of a ten per cent. solution of bromide of potassium to each ounce of developer, which will then contain one and a half grains quinol, six grains eikonogen, eighteen grains soda sulphite, twelve grains potassium carbonate, and one-fifth grain of bromide.

167. **Mixed quinol and metol developer.**—The formula for the "Imperial Universal" developer is as follows:

No. 14—Quinol-metol developer.

A.	
Metol	40 grains.
Quinol	50 ,,
Sodium sulphite	120 ,,
Potass. bromide	15 ,,
Distilled water to	20 ounces.

B.	
Potassium hydrate (caustic potash)	180 grains.
Distilled water to	20 ounces.

For use.—Take equal parts of A and B. Each ounce of the developer contains one grain of metol, one and a quarter grains of quinol, three grains of sulphite, three-eighths of a grain of bromide, four and a half grains of potassium hydrate. It is a very energetic developer.

168. **Mixed pyro and metol developer.**—The formula for the "Imperial Standard" developer is as follows:

No. 15.—Pyro-metol developer.

A.		
Pyrogallic acid ...	...	55 grains.
Metol	...	45 „
Metabisulphite ...	...	120 „
Potassium bromide	...	20 „
Water to	...	20 ounces.

B.		
Soda carbonate ...	...	4 ounces.
Distilled water to ...	...	20 „

For use.—Take equal parts of A and B. Each ounce of this developer contains one and three-eighth grains of pyro, one and one-eighth grains of metol, three grains of metabisulphite, half a grain of potassium bromide, forty-eight grains of soda carbonate.

169. *Portable developers* are sent out in the shape of compressed pellets, tabloids, and cartridges, by several makers. They would be much more generally used if *the component parts of each pellet or tabloid were specified on the package.* Most practical men object to using developers of unknown proportions.

CHAPTER VII.—DEVELOPMENT.

170. **The dark room.**—Development should always be carried on "by *artificial* light, for by this method there is a more regular standard by which to judge of the quality of the negative than if the varying strength of daylight is trusted to."

When using artificial light, it is an advantage if the lamp or gas can be placed *outside* the window of the developing room, so as to avoid the heat and unpleasant fumes.

But either artificial light or daylight must be rendered safe by the interposition of some non-actinic material. The recommendations on this point are numerous. Let it suffice to say that yellow light is the most *pleasant* to work with; ruby or orange is generally considered *safer*, but is trying to the eyes. With a green light I have found it very difficult to judge of the density of the negative. A ruby light is essential for orthochromatic plates.

"Golden" or "ruby" fabrics, or canary or orange paper, either pasted against the window or placed in double or treble thicknesses between two sheets of glass, are commonly used.

When red or yellow glass is employed, instead of fabric or non-actinic paper, it should be "frosted" to prevent the unpleasant glare, and this may be readily done by dabbing one surface with a piece of putty and allowing it to dry, or by flowing mat varnish over it. When canary or orange paper is used, it may be made semi-translucent with vaseline or oil.

Mr. Beaufort, of Birmingham, soaks sheets of white blotting paper in red ink, dries them, and floats on melted paraffin. He then lays them between two sheets of clean glass, and binds the whole with strips of gummed paper. The light is said to be safe, and very soft to the eyes, but a ruby curtain should be used in addition during the first stages of development.

171. The eyesight of many people is affected by the use of red light in the dark room. It is then a good plan to have a green blind to pull down over the red light when development is complete, and thus to ease the eyes with this softer light before going out into ordinary daylight.

172. The safety of the light *should be carefully tested.* It is surprising how many workers omit this most obvious precaution. To prove the quality of the light, place a dry developing dish on the spot where it generally rests during development, and into it put a new sensitive plate. Cover half of the plate with a card, or bit of non-actinic paper, and let it remain for twenty minutes or even more. Then develop in the usual manner, and if the plate shows any discoloration the source of light should be made more non-actinic.

Have *as much* light as possible, provided it is of the right quality, but remember that even the best non-actinic light will act to a certain extent on rapid plates if the development is long continued. In such cases cover the developing dish with a sheet of orange or ruby glass, or a light cardboard cover.

When using very sensitive plates, development should be carried on at as great a distance as possible from the source of light, and where the space in the dark room is confined, safety may be ensured by holding the developing dish in the hand, and turning the back to the light until the picture is well out. The plate should not be held up to the light for examination until development has far advanced, and then only for the shortest possible time.

173. A light box, without a cover, large enough to be inverted over the developing dish, and deep enough to cover it down to the developing table on all sides, should always be kept in the dark room, to be used if for any reason the door has to be opened before development is finished.

Some operators find mechanical rockers useful, but care must be taken that sufficient developer is made up to fully cover the plate; this will generally be about twice the quantity needed when the plate is rocked by hand.

174. **Development maxims.**—Light makes a certain definite impression on the sensitive plate, and no development will evolve more than is already there.

In very hot weather developers should be made weaker than the normal strength.

When distilled water is not available, boiled water, after it has been allowed to cool, is nearly as good.

As a rule, plates should not be soaked in water previous to development.

Thickly-coated plates require to be developed to a much greater density than ordinary plates, as a great deal of the apparent density goes off in the fixing—see also para. 194.

Err on the side of over—rather than under—density. Beginners are liable to over-expose and under-develop. It is easier to reduce a negative than to intensify it.

With ordinary plates, the readiest test of the density of the negative is the appearance of the high lights on the *back* of the film, but with thickly-coated plates the high lights only show faintly.

175. **Temperature and development.**—In cold weather the developer is less active, and the negatives are liable to be hard. "A developer at 55° F. acts three times slower than it would at 60° F."

In winter the developer, fixing bath, and washing water should be warmed to about 60° F. Many developers, especially quinol, are almost inert when ery cold.

In very hot weather the developer is abnormally active, and is liable to roduce weak or fogged negatives.

Not only should the solutions be warm, but the dark room also should be kept at an equable temperature of 60° or 65°. Where gas is not laid on, an oil warming stove may be kept in the dark room until it is sufficiently warmed, it being removed when about to commence work.

176. **Methods of development.**—No two workers probably develop in exactly the same way, but the practice of the large army of photographers may be classed under the following heads: Quick development, slow or tentative development, and phantom development.

Quick development.—This is the old "rule of thumb" method, and there are some who still adhere to it. The prescribed developer of full strength is poured on the plate, the picture rapidly appears, and *if* it has been *accurately* timed it may prove to be in every respect as good as one obtained by the slower process, but if the negative should happen to have been over-exposed, the image flashes out, and is probably ruined before any remedy can be applied. For studio work, where the conditions of exposure are constant, rapid development is perfectly legitimate, but for outdoor work it is unsafe.

Slow or tentative development.—This consists in commencing with the developer in the normal proportions, with the important exception that at first only about *half the alkali is mixed in*, the remainder being added in small portions from time to time as found to be necessary. On this system the development proceeds slowly; the operator is enabled to watch his work and to modify the proportions of his developer as required.

Phantom development is simply the slow process above described carried to greater lengths, and is chiefly required in exceptional cases. A weak developer is used, and is still further diluted with two or three times its bulk of water, the development then proceeds *very* slowly, and time is given to the shadows to attract their due share of deposit, whilst the weakness of the developer prevents the high lights from being overdone. A phantom image results which, though weak, is fairly true in gradation. The dilute developer is then thrown away, the plate well washed, and the development completed with a fresh solution of normal or modified strength until sufficient density is attained.

177. **Effect of diluting the developer.**—The possibility of diluting the developer places a great power in the hands of the operator. By weakening the developer its action is rendered slower, *contrasts are reduced*, and more detail is brought out without making the high lights too dense, hence the value of diluting the developer in cases of under-exposure, or in treating subjects with very violent contrasts.

During the washing after development, a plate gains appreciable density and some little additional detail. This effect is probably caused by the dilution of the developer remaining in the film by the washing water. Some operators always wash their plates once or oftener during development, with the view of bringing out more detail. After such washing the developer is returned to the plate, which rapidly gains density.

It sometimes happens when treating even a correctly-timed plate with the ordinary developer that after development has proceeded up to a certain point it stops short, and no further density can be obtained. When this occurs the old developer should be thrown away, the plate thoroughly washed, and then treated with a fresh developer of full strength.

178. **Local application of the developer.**—Insensitive portions of an otherwise good negative may be improved by a little management. When the picture is nearly intense enough, turn the developer off the plate,

and then, holding the developing glass a few inches high, pour the developer over the insensitive patches. Repeat this again and again, and a sensible increase in detail will often be brought out. Tilting the dish, so that the developer may act chiefly on the parts which require more density, is also useful, but when the insensitive parts of a negative are not conveniently reached in this way, the developer should be poured off and detail brought out with a brush dipped in the developing solution.

179. **Local application of the restrainer.**—In like manner excessive action may be controlled by the local application of the bromide solution, and this is specially useful when halation makes itself apparent in negatives of interiors. It is even possible to obtain by this means a natural sky with clouds in an ordinary landscape negative, the sky being painted with a ten per cent. solution of bromide of potassium as soon as its limits are apparent during development. When this is done, the dish should be tilted and the developer kept as much as possible on the foreground, so as to lessen its action on the sky. But this practice is tedious and uncertain except in skilful hands, and the ordinary method of printing in clouds from a separate negative is therefore usually adopted. A ten per cent. solution of citrate of soda may be used instead of bromide, but in either case the solution must be washed off before proceeding with the development.

180. **Composition of developers.**—The chief constituents of most developers are as follow, but certain of the "aniline" series have the power of developing without the addition of an accelerator:

(1.) *The density giver*—pyro, quinol, or other similar substance.*
(2.) *The preservative*—sulphite of soda, or citric or other acid, etc.
(3.) *The accelerator*—ammonia or one of the fixed alkalies such as soda or potash.
(4.) *The restrainer*—bromide of potash, or ammonium, etc.

Bearing the above clearly in mind, the reasons hereafter given for modifying the developer to meet certain requirements will be better understood.

181. **Plate-makers' formulæ.**—The variety of formulæ sent out with plates of various makers is endless. Practically, most plates can be developed with any average formula with the use of which the operator is familiar, though it is always desirable to note the proportion of each ingredient of the developer recommended by the makers of the plates he is using, and to be guided accordingly.

When using the pyro-ammonia developer, the novice is very strongly recommended from the very commencement to think of it not as Thomas's or Mawson's, or other formula, but as a developer containing *so many grains of pyro, ammonia, and bromide to the ounce;* he will thus work far more intelligently than if he used it without any clear idea of the proportions of its constituents.

182. **Ten per cent. solutions.**—To aid him in doing this, the components of his pyro-ammonia developer should all be kept in ten per cent. solutions in dropping bottles, viz., one bottle for the pyro and sulphite, etc., one bottle for the ammonia, and one for the bromide restrainer. Every ten drops of each solution will then contain one grain of the chemical, and he can construct or modify his developer with ease and judgment. The

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* The alkali also contributes to give density, inasmuch as it initiates and keeps up the reducing action of the pyro, etc.

analysis of each maker's formula is published annually in the photographic almanacs, and will show the proportion of each to be used. For work at a distance from home, the solutions may be more concentrated, but each must always contain a definite percentage of the active ingredient, so that there may be no difficulty in dropping out the number of grains or minims required.

When using a "three solution" pyro developer, as described above, it must be remembered that a due proportion of bromide must always be added to the developer with each quantity of alkali. Thus, if the normal developer prescribes two minims of ammonia and one grain of bromide, and if development is commenced with half the ammonia (one minim), half the bromide (half grain) should be then added, and the remainder of the bromide with the rest of the ammonia as development proceeds.

Many operators prefer to add the bromide to the stock solution of ammonia, thus making what is called a "two solution" developer; this saves some trouble and ensures the proportionate addition of bromide with each increase in the amount of alkali added to the developer, but even when this plan is adopted, a separate bottle with a ten per cent. bromide solution should be kept handy to meet cases of over-exposure.

Some do not mix the pyro with the sulphite or other preservative, but add it *dry* to the developer just before use. In this case, the sulphite is kept in a thirty-three per cent. solution, with the usual proportion of citric or other acid, and mixed with the developer when being made up, usually in the proportion of three or four grains of sulphite to each grain of dry pyro.* Very little practice will enable the operator to take up direct from the bottle (with a bone mustard spoon) a grain or more of dry pyro at a time without the necessity of weighing. A gum-bottle, with a hollow glass cover to receive the handle of the bone spoon, is convenient for keeping the dry pyro in, and whilst working it should be laid on its side to facilitate the removal of the contents.

PRACTICAL DEVELOPMENT.

183. Exposed plates ready for development may be roughly divided into three classes, viz.:

1st. Normal subjects possessing due gradation of tone and correctly exposed.

2nd. Those in which *excessive contrast* may be looked for, either naturally, from the nature of the subject itself, or produced artificially by *under-exposure*.

3rd. Those in which *deficient contrast* exists in the subject, or is artificially produced by *over-exposure*.

For the first class of subjects no special instructions are necessary beyond the general rules already given. The main thing is to *develop slowly*, adding the alkali (with its proportion of bromide) by degrees, and to watch results.

EXCESSIVE CONTRAST AND UNDER-EXPOSURE.

184. Subjects with excessive contrast, and under-exposed plates, if treated with the normal developer, can only be expected to yield hard negatives.

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* Some dispense with sulphite (or other preservative) altogether, but the developer then rapidly decomposes, and the negative acquires a yellow stain, which can, however, be removed in a great measure in a clearing bath of alum and citric acid. When the sulphite is omitted, the pyro is generally used dry.

Everything should therefore be done to bring out the detail, whilst controlling as much as possible the tendency to over-density.

Some of the developers which have been introduced within the last few years are often found to act better than pyro in cases of under-exposure. Eikonogen, amidol, and metol are very effective in urging out detail, without at the same time clogging the high lights. They must be used *weak* in commencing development, and the weak image subsequently intensified by a stronger developer.

But, if the pyrogallic developer is preferred, reduce the proportion of pyro, increase the alkali, use only sufficient bromide to prevent fog, and, above all, *dilute the developer*—see para. 177. With much under-exposed plates more than the normal amount of alkali prescribed by the formula may have to be used.

The development of negatives of subjects with great contrasts should not be carried too far, or the comparatively soft effect which has been gained by the use of a dilute developer will be lost. Neither must it be hurried if good results are wished for.

Interiors, snow and Alpine scenes, dark glens, and many other subjects require to be treated as above.

DEFICIENT CONTRAST AND OVER-EXPOSURE.

185. In cases of deficient contrast and over-exposure, the object is to increase the lacking contrast by all possible means. Here, again, the selection of a suitable developer is very important. By exercising patience sufficient density can usually be got with a pyro developer, provided the over-exposure has not been very excessive. The amount of pyro in the developer should be largely increased, the alkali greatly reduced, and sufficient bromide used to keep the shadows clear, and this is particularly necessary if the negative should have to be subsequently intensified.

Of the other developers, metol without alkali is perhaps the best for over-exposed plates.

To provide against unforeseen cases of excessive over-exposure, a weak solution (five grains to the ounce) of citric acid should be at hand. If the picture flashes out on first applying the developer, return the developer to the glass, and flood the plate with the acid water. Whilst soaking in this, make a fresh developer more suited to the case; then pour away the acid water, and after washing the plate, throw on the new developer. A neutral ten per cent. solution of ammonium citrate, or a ten per cent. solution of potassium bromide, may be used in the same way.

186. **Development on tour.**—Experienced operators have by long and careful practice become so habituated to judging exposures that when away for a photographic holiday they seldom develop their negatives (especially small ones) until after their return home, but when working large plates, or when taking special subjects where it is difficult or impossible to judge the correct exposure, an occasional trial plate must be developed. The very simple apparatus described in para. 62 will suffice. The fixing *may* be delayed until after returning home, the negative being well washed after development, treated with a ten per cent. solution of bromide, dried and protected from light, but if development whilst on tour is done at all, it is as well to complete the whole process on the spot.

187. *Hand-camera negatives.*—There is ordinarily no reason why a rapidly exposed or so-called *snap-shot or instantaneous* picture should be developed differently from any other, provided the exposure, however short, has been (relatively to the size of aperture, quality of light and sensitiveness of plate) sufficient. But where instantaneous work practically means *under-exposure*, it must be treated as such, the oxidising element (such as pyro) should be much reduced, and the developer diluted with two or three times its volume of water or even more, and the development cautiously and patiently continued until the required result is obtained. Amidol and metol are excellent developers for hand-camera "snap-shots," metol being perhaps the best.

188. *Multiple development.*—The beginner will do well not to try to develop more than one negative at a time, but when large numbers of small exposed plates have to be treated, and when the exposures are known to be fairly accurate, the experienced operator often saves time and labour by developing several plates in one dish, which he does with a developer containing, as usual, only half the normal quantity of alkali. If any of the plates show signs of over or under-exposure, he transfers them to other dishes ready at hand, and treats them with developers modified to suit the circumstances. It requires, however, some skill and practice to develop several plates in one dish with success.

189. *Dipping bath development* would be exceedingly convenient for hand-camera workers who often have a large number of negatives to develop at one time, if only photographic apparatus makers would modify their porcelain grooved baths by sloping the grooving so that a plate of glass might be fitted into every alternate groove, thus making a bath with five or six cells, which, with the aid of a few glass *dippers*, would be capable of developing the same number of negatives. The developing solution would necessarily be weak, and Dr. Meydenbauer found pyro better than any of the new developers, as the latter do not permit such extreme dilution as he used, viz., one part pyro to five hundred of water.

190. *Development of films.*—Thick films are treated in every respect like glass negatives. Most of them dry with a slight curl, which is not practically inconvenient, as they must necessarily be printed in a printing frame with a glass front, but if this curl is objected to, they may be treated, after fixing and washing, with a weak solution of glycerine (half ounce to the pint of water), and then hung up to dry.

191. It will be gathered from what has been said above that it is believed that each developer has its own specific quality, and is more useful for certain purposes than for others, also that various methods of using the same developer produce different results in the negative. The subject of the relation between development and gradation is too complex to be entered into here, but reference may be made to a paper read before the Photographic Convention of the United Kingdom, 1893, by Mr. C. H. Bothamley, entitled "Some points in connection with development."

On one point, however, there can be no doubt, viz., that *the maximum detail obtainable for a given exposure is the same for all developers and for all variations in the composition of one and the same developer*, though different developers differ very considerably in the *time* required to make the maximum detail visible.

CHAPTER VIII.

FIXING, WASHING, AND VARNISHING NEGATIVES.

After the negatives have been developed, they still need fixing, washing, aluming, and varnishing.

The most convenient vessel for holding the fixing solution is an upright dipping bath, like those formerly used in the wet collodion process. It may either be of glass, porcelain, or ebonite. A set of three of these baths may be conveniently arranged in an open box, the baths being slightly inclined from the perpendicular for convenience in inserting the plates—see fig. 10.

192. **Ordinary fixing bath.**—In practice it will be found that one part of hypo to five of water is a good proportion, because this bath does not act too quickly; a plate may be left in it whilst a second is being developed, and there is then no need of touching hypo whilst development is going on. For thickly-coated plates the bath must be stronger (one to three), or they will take too long to fix.

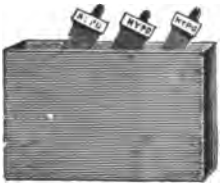

Fig. 10.

It is best to use two baths of the same strength, and after the opalescent tint of the bromide has been dissolved out by the first bath, to transfer the plate to the second, and allow it to remain an equal time. This ensures thorough fixing, for it is more often from *insufficient fixing*, rather than from faulty washing, that negatives fade.

When first removed from the fixing bath, the negative should be rapidly washed in *subdued light* in several changes of water, as the hyposulphite of silver in the film is sensitive to light. It is therefore a mistake to suppose that negatives can be safely fixed in open daylight, even after they have been thoroughly cleansed from the developer.

The fixing bath is occasionally thought to reduce the density of negatives too much. For pyro negatives ten or fifteen drops of ammonia may be added to each pint of the bath, but negatives developed with quinol, eikonogen, amidol, or metol, should not be fixed in an alkaline bath—see para. 193.

It will be found a great convenience to make up a considerable quantity of hypo solution (one to five), and keep it in a stoneware keg with a wooden tap—any quantity can be drawn off as required, and can be diluted, if need be, for fixing prints, etc.

If at any time a doubt arises whether the time allowed in the fixing bath is sufficient, the fixed and washed negative should be treated with a bath of iodide of potassium, which will produce a visible opalescence if any undecomposed silver remains on the film. When this is the case, the plate must be again placed in the ordinary fixing bath, and future plates must have longer fixing.

For dry collodion plates the fixing bath may be cyanide of potassium ¼ ounce, water 10 ounces, or the above hypo bath (one to five); but the cyanide fixing bath must *not* be used for gelatine plates.

193. **Acid fixing bath.**—This bath remains as clear as water if the plates are fairly washed before being immersed. After use, keep in a stoppered bottle.

No. 16.—Acid fixing bath.

Hypo	4 ounces.
Soda bisulphite	1 ounce
Water	20 ounces.

The acid fixing bath is best suited for negatives and lantern plates developed with quinol, eiko, amidol, and metol. It *may* also be used after the pyro developer, but it removes the faint straw-coloured bloom which many consider to add to the beauty of pyro negatives, and to contribute to their effectiveness in printing.

194. *Loss of density in fixing.*—Much of the loss of density in fixing is more apparent than real. The bromide of silver in the unfixed film being semi-opaque makes the negative look far denser than it really is, and when this bromide is subsequently dissolved out in the fixing bath, the picture looks less dense than before, though it may not have been actually weakened. But in the case of several of the new developers of the aniline series, there appears to be an actual weakening of the image in the fixing bath, and this must be allowed for by developing to greater density.

195. **Automatic washers for negatives.**—Of these there are endless patterns. A few glazed earthern or enamelled iron dishes will answer in the absence of a special washing apparatus, especially if the water is frequently changed, and their efficiency is greatly increased if they are procured of a size which just allows the plate to rest a short distance above the bottom; the film is then put *face downwards*, and the washing is much more rapid. Common pie-dishes answer well.

196. **Washing films.**—*Thick* films will wash like plates in the grooves of any ordinary washing rack. Two may be put back to back in each groove. *Thin* films require a special rack in which they can be suspended by clips—see arrangement by Mr. C. Stephens in *Amateur Photographer*, 10th March, 1893.

197. **Aluming and clearing negatives.**—After thoroughly washing out the hypo, the plate should be soaked in a saturated solution of alum. If the negative is much stained by prolonged development, the following clearing bath may be used instead of the plain alum solution, but it must be remembered that the citric or any other acid greatly reduces the tanning effect of the alum, so that it is best to first *flush* the plate with one dram of sulphuric acid to ten ounces of water, then wash thoroughly and put the negative in the plain alum bath.

No. 17.—Clearing bath.

Alum	1 ounce.
Citric acid	½ ,,
Water	10 ounces.

198. After the negative has been finally washed it should be well swabbed (while still wet) with a soft camel-hair brush,* whilst a stream of water is allowed to fall on it from the tap, or, where there is no tap, the negative should be swabbed whilst an assistant pours water from a jug over it. This removes the grit or impurities that have adhered to the surface during the washing. Films may be hung up to dry by the clips figured at para. 292.

199. If it is required to dry negatives *very quickly*, first wash thoroughly, and then flood the plate several times with pure methylated spirit, but what is sold as "finish" by colourmen should not be used, as it contains resin. Films must *not* be treated in this way, as the alcohol acts on the celluloid. A plate is, however, best allowed to dry slowly and naturally. Drying negatives in a strong light is said to make them more brilliant —see also para. 413.

200. **Removing sharp edges of negatives.**—Who has not experienced cut fingers when cleaning a negative? A simple means of avoiding this is to procure a coarse emery rubber, about six inches by three inches, or any other suitable size, and to grind the edges of the negative, back and front, on this a few times. This thoroughly removes the sharp cutting surfaces, and facilitates the adhesion of the varnish.

201. **Varnishing.**—A valuable negative cannot be considered safe until it is varnished. It is a troublesome and somewhat messy operation, but should not be shirked. First, however, a single proof may be taken from the unvarnished negative if there is any doubt whether either reduction or intensification, local or general, is necessary.

Hot varnish.—The best varnishes are probably those of which shellac forms the principal ingredient, and methylated spirit the solvent. The only drawback to the use of lac-varnish is its slight yellow colour; this, however, is barely perceptible, and is practically harmless as long as the varnish is kept thin, and ridges are not allowed to form near the margins.

Before applying the varnish the plate must first be slightly warmed, otherwise the varnish will "chill" and dry with a dull surface—not that this is any great disadvantage, but the transparent plate looks better. The varnish is poured on the warmed plate in the same way as collodion, and poured off (into a *separate* wide-mouthed bottle) with a rocking motion to prevent diagonal lines. When the drip has nearly finished, pass a piece of clean rag along the two lower edges of the plate to absorb the surplus varnish, and so prevent a little wave setting in and forming a ridge about a quarter of an inch from the margin of the plate. Now warm the varnished side over the lamp, and it will speedily set and harden. Clean off the back of the negative with a little bit of rag and methylated spirit, give the plate a consecutive number with a fine brush and a little oil paint, enter its title or number in an index list, and put it away in its plate box. A numbered list of negatives should be pasted inside the cover of each plate box.

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* The best kind of brush is what is called a camel-hair "dabber"; it is mop-shaped, and mounted in split quill. The flat brushes mounted in tin are very liable to scratch the negative when used in this way with water.

202. Several little things have to be observed to ensure success, though no written description can take the place of practice.

The plate must not be too hot, or the varnish will dry thick and in ridges, nor too cool, or the varnish will chill. When the warmed negative is applied to the thin skin of the back of the hand, in the neighbourhood of the finger and thumb, it should feel thoroughly warm, but not unpleasantly *hot*.

When the whole of the contents of the original bottle have been transferred during the process of varnishing to the second (wide-mouthed) bottle, carefully filter (all but the dregs) back, without shaking, into the original bottle, first wetting the filter paper with strong methylated spirit, and covering the filtering funnel with a piece of glass to retard the evaporation of the spirit. Thin the varnish when necessary with the very *strongest* methylated spirit procurable—weak spirit spoils the varnish.

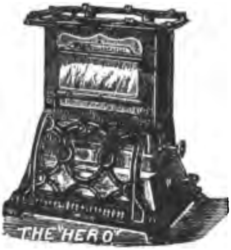

Fig. 11.

Any small paraffin stove will answer for varnishing. The figure here represented shows a very convenient pattern, which also does well for warming solutions, etc., etc.

203. *Varnish not waterproof.*—It must never be forgotten that no spirit varnish is proof against water, and that a few drops of liquid, carelessly thrown about and allowed to remain, will star the varnish, and indelibly stain the plate. If the negative is a valuable one, the varnish should be removed by the process given in para. 189, the plate well washed, dried quickly, and re-varnished, but the stains are seldom completely removed, though they may show less in the prints.

204. When very few prints are to be taken from negatives they may be protected by flowing over them a tough collodion made for the purpose, but the protection is not so good as that afforded by spirit varnish. Some use retouching medium instead of ordinary varnish.

205. *To remove varnish.*—I have found very effective the following process recommended by Mr. Wellington: Place the negative in methylated spirit, to which has been added a little liquor ammonia. Let it soak for five or ten minutes; then replace the spirit and ammonia with water and ammonia, and finally wash in plain water. The action of the solutions may be aided by gently rubbing the surface of the negative with a pledget of cotton wool.

206. **Cold varnish.**—But the application of spirit varnish, though not difficult after some little practice, is considered too much trouble by many; a cold varnish *(which is also suitable for films)* is, therefore, a great convenience, especially as it may be applied to the wet negative directly the

washing is completed, and the whole process finished at one operation. The following formula is given by Mr. T. N. Armstrong in the *British Journal of Photography*. It is similar to the one given in previous editions of this book, but is perhaps preferable to it.

No. 18.—Cold varnish for plates or films.

"Take four ounces of shellac, in thin flakes, and twenty ounces of water, raise to the boiling point, and when this is reached, add a few drops of a hot saturated solution of borax, stirring vigorously with a glass rod till the shellac is dissolved, which will be in a few seconds. Don't use too much borax, but add it slowly, and stop short of complete solution rather than the other way. After this, filter through charcoal, and the water varnish is ready for use. After the negative has been well washed, and while it is still wet, immerse it in a dish of the cold varnish. Plates may afterwards be varnished in the usual manner with spirit varnish, if considered necessary. Plates treated with this cold varnish are said to be absolutely proof against such silver stains as are commonly met with" Films, after development and final washing, may be soaked in this varnish whilst still wet, and then hung up to dry. The above formula is given for the benefit of those who may be working in out-of-the-way places, where access to a photographic dealer is not possible; but the ordinary amateur will find it more convenient and cheaper in the end to purchase the smaller supplies he requires. For plates I have used an excellent cold varnish by Mawson, and a celluloid varnish by Tylar, and there are probably many others equally good, but celluloid varnish is not suitable for *films*.

STORING AND REPRODUCING NEGATIVES, &c.

207. **Storing negatives.**—Where negatives accumulate, and are not in constant use, a portion of them (especially the duplicates) may be stored in the empty cardboard boxes in which the plates were originally received, each pair of plates being put face to face, with a bit of filtering paper interposed. The boxes, being then labelled on the back with a brief description of the contents, may be ranged like books on a shelf, and are thus always ready for reference. It should not be forgotten that the aggregate weight of a large stock of plates is very great, and tries severely the flooring of the room in which they are stored.

208. **Transmission of negatives by post.**—Procure a stout wooden box somewhat larger all round than the negatives to be enclosed. Line all four sides with several thicknesses of the ordinary corrugated packing paper, cutting the slips so that the corrugations may run alternately vertically and horizontally. Then lay three or four thicknesses of the same paper on the bottom of the box, the corrugations crossing each other as before. On this bed lay a negative well wrapped in soft paper, then more sheets and another negative, and so on, finishing off with a sufficient number of sheets of the corrugated paper at the top of all to keep the contents quite firm. Screw (not nail) on the lid.

Another good plan is to shake a layer of bran into the box. On this lay the first negative, wrapped in soft paper, and sift in more bran, and then another negative and bran alternately, finally filling the box *quite full* with bran, and thoroughly shaking it amongst the negatives before the lid is *screwed on*.

209. **Stripping negatives.**—For this purpose, Liesegang says that sodium fluoride may be substituted for hydrofluoric acid to very great advantage, as it does not possess the strong corrosive properties of the

latter. By immersing the negative in an aqueous solution of sodium fluoride, the film will float away. If it is desired that the film should not expand, it should first be coated with collodion. If not so protected, the film will expand considerably, and when reapplied to glass an enlarged negative will be obtained.

Our recent experiments with sodium fluoride have given good results. The procedure was as follows:

No. 19.—Stripping solution.

A.		B.	
Sodium fluoride	2 drms.	Strong sulphuric acid	2 drams.
Water	10 ounces.	Water	10 ounces.

C.

Chrome alum—saturated solution.

If it is required to strip *without enlarging*, soak the dry negative in the chrome alum solution for thirty minutes, wash, and dry it. Then place the dry negative in solution A for five minutes; take it out, and, without washing, transfer it to solution B—it will speedily strip from the glass. Gently lift the detached film on its glass, and transfer it to a dish of clean water. Now slip under it a fresh glass of suitable size, and, while still under water, arrange the film on the glass in the position desired. Lift it out carefully, smooth down the wrinkles with a moist camel-hair brush, and then rear it up in the usual way to dry.

If it is wished to strip and at the same time to *enlarge the film considerably*, the soaking in chrome alum must be omitted. If it is desired to strip and *slightly enlarge* the film, soak the negative in the chrome alum for *ten* minutes only, wash, and, without drying, place in solution A, and continue the process as above.

Mr. Roy publishes the following method of stripping films from negatives on glass so as to secure negative pellicles for carbon printing and for photo-mechanical work. The negative to be stripped is immersed for fifteen or twenty seconds in a bath composed of:

No. 20.—Stripping solution.

Water	100 grammes.
Formol	50 "
Glycerine	5 "

and is then allowed to dry. Next, the sharp point of a penknife is passed round the four sides of the negative, about 2 mm. from the edge of the plate, so as to cut the film clean down to the glass. Then the negative is immersed for three or four minutes in a twenty per cent. solution of sodic carbonate, and, immediately after, *without washing*, in a five per cent. solution of hydrochloric acid. A rapid evolution of gas is followed by the complete separation of the film from its support. The film is received on a sheet of glass, previously chalked and collodionised, a squeegee is applied to secure perfect adhesion, and, after drying, a coating of collodion containing a minute quantity of castor oil is given. When the whole is dry the film can easily be peeled off. It will come off quite flat and without the slightest alteration from its original size.

Another formula for the same purpose is published by I.R.R. Soak the plate in alcohol 6 ounces, water 2 ounces; then immerse in hydrochloric acid ½ ounce, alcohol 6 ounces, water 4 ounces, and the film will float off the glass without enlarging the slightest.

A preparation sold under the name of "Cresco-fylma" is convenient for stripping negatives. Care should be taken that the water used in the process is free from suspended impurities, which would adhere to the transferred film.

A cracked negative may be transferred by these methods, provided the film itself is not broken.

210. **Duplicating negatives.**—Whenever that *rara avis*, a *perfect* negative, is secured, proceed at once to make a transparency from it. From this transparency any number of duplicate negatives may be printed, and this will be found very useful for book illustration, where a large number of copies are required in a limited time. In the case of landscapes, by carefully printing clouds into the transparency, the duplicate negatives will be complete in themselves, and require no double operation when being printed from.

For instructions for making improved duplicates from defective negatives see *British Journal Almanac*, 1894, page 700.

CHAPTER IX.—INTENSIFIERS AND REDUCERS.

211. It must always be remembered that intensification will not bring out anything that is not actually *visible* on the plate; it will only add to what is already there. A plate which has abundant detail and clear shadows, but is otherwise weak, may be improved by intensification; whilst one that is lacking in detail, or shows traces of fog, would be deteriorated rather than improved.

There are many formulæ for intensifying, but a safe, simple, easily-worked, and permanent process seems still to be wanted.

The dishes for intensification or reduction should be of white porcelain, so that the effect which is being produced may be easily seen, and the process is advantageously worked in a subdued or yellow light, or by candlelight.

212. All intensifiers have to be used intelligently, with the knowledge that, generally, the image is not only strengthened, but sometimes changed in colour, and that a subsequent and detrimental change is to be expected if the process is not most carefully carried out.

213. *Thorough washing of negative essential.*—Before using the mercurial and uranium intensifiers, a most thorough washing of the film is *absolutely essential.* The presence of the smallest trace of hypo is fatal to success. As an additional precaution, all valuable negatives should be soaked again in an acid clearing bath (No. 17), even if they were alumed in the first instance, and should then be well washed before being placed in the mercurial solution. A negative may be intensified either before or after it is dry; in the latter case it must be first *thoroughly* soaked in water, say, for at least half-an-hour.

214. **Mercurial Intensification** is, perhaps, the most commonly used of any. Numerous modifications of the process will be found in the text books; it will suffice to give here the one which has been found most effective.

Bleaching the negative.—The first step in the process of mercurial intensification is to bleach the negative in an acid solution of bichloride of mercury.

No. 21.—Mercurial bleaching solution.

Mercuric chloride saturated solution	10 ounces.
Strong hydrochloric acid	15 drops.

Immerse the plate in this. If the negative is very weak and requires much strengthening, the bleaching should be continued until the whole of the film shows white when looked at from the glass side, but if a smaller degree of intensification is desired, the bleaching must be stopped at an earlier stage. The bleached negative must then be washed to get rid of the free bichloride of mercury remaining in the film, and this should be done *most thoroughly.*

Darkening the film.—When only a slight increase of opacity is required, a ten per cent. solution of *sulphite of soda,* acidulated with ten minims of acetic acid to each ounce, is sometimes used, but the change effected is chiefly in the *colour* of the negative. It is always very slight, and often quite imperceptible, and because of this uncertainty the darkening with sulphite is *not to be recommended;* nor is the use of ammonia for darkening the film desirable. It is uncertain in its action, and tends to clog the details of the negative.

The better plan is to treat the bleached film exactly as if it were a freshly-exposed plate, and develop it accordingly. Any developer may be employed, the best is the ferrous oxalate, which is used exactly as prescribed for bromide paper (No. 35), and it is essential that it be acid as in the formula given. The proportions to be used are oxalate 6 parts, iron 1 part. After intensification with ferrous oxalate, it is desirable to treat the plate with the acid clearing solution (No. 35D) to guard against any deposit of lime or iron in the film during the subsequent washing. If sufficient opacity is not gained the first time, the bleaching and darkening may be repeated as often as necessary, and the negative will gain opacity after each operation.

A pyro developer gives considerable density to the bleached film—quinol is less energetic, but no developer is found so generally suitable as the ferrous oxalate. An old developer that has been already used is as good as a new one for intensifying, providing it has not altogether lost its power.

Even when the preliminary bleaching of the image is only partial (as when a *slight* increase of opacity is merely needed) the blackening or developing reagent must be allowed to penetrate *completely through the bleached film.*

214A. There are several formulæ for silver intensifiers, many of which (*e.g.*, Monkhoven's and Wellington's) contain cyanide. These are emphatically condemned by Mr. Chapman Jones, an excellent authority on the subject.

215. **Copper Intensifier.**—Dr. Liesegang strongly recommends this process, and the favourable opinion is endorsed by Dr. Erichsen, but the process appears to need great nicety of manipulation—see *Photographic News*, 21st August, 1896.

No. 22.—Copper intensifier.

A.		B.	
Sulphate of copper ...	75 grains.	Nitrate of silver	90 grains.
Bromide of potassium ...	75 ,,	Water	4 ounces.
Water	6_2 ounces.		

After the negative has been *thoroughly* washed it is placed in solution A till sufficiently bleached. It is then thoroughly washed and immersed in solution B till fully blackened, and again washed thoroughly. This intensification should be conducted in a dark room or in subdued light.

216. **Uranium Intensifier.**—There are several formulæ for uranium intensifiers, the principal ingredients in all of them being nitrate of uranium and ferricyanide of potash, either with or without acetic acid. In Eder's

and Vogel's formulæ the uranium and ferricyanide are mixed before use, but Schrank applies them separately; there is, however, in the latter process the disadvantage that the uranium solution which is first poured on makes no *visible* change in the negative, and the intensification is therefore apt to get beyond control when the ferricyanide is subsequently applied. I therefore prefer Vogel's formula, which is as follows:

No. 23.—Uranium intensifier.

A.		B.	
Uranium nitrate... ...	20 grains.	Potassium ferricyanide ...	20 grains.
Acetic acid	½ ounce.	Acetic acid	½ ounce.
Water	10 ounces.	Water...	10 ounces

For use.—Take equal parts of A and B, and do not mix more than is required for immediate use, as the mixed solution does not keep. Soft water should be used for washing after uranium toning—water that is alkaline reduces the intensity.

The uranium intensifier can, if necessary, be removed from the whole plate or from parts only by dilute ammonia, and by long-continued washing it can also be reduced, consequently when it is not desired to lower the intensification of the negative it should not be washed for more than a quarter of an hour. The intensification consists chiefly in the change of the colour of the film to a deep non-actinic red or reddish-brown.

Mr. Chapman Jones points out that if this intensifier is applied with care, so that its action is only partial and does not penetrate far into the film, it strengthens the shadows proportionately more than the lights.

When negatives which have been intensified with uranium are subsequently varnished with a *spirit* varnish, the density of the deposit is much reduced; this may be remedied by first coating the negative with weak gum water.

217. *Intensifier for dry collodion plates.*—Dr. Hill Norris gives the following formula for intensifying (redeveloping) dry collodion plates which have first been fixed and washed.

No. 24.—Intensifier for collodion plates.

A.		B.	
Pyro	20 grains.	Silver nitrate...	10 grains.
Citric acid	50 ,,	Distilled water	1 ounce.
Water	4 ounces.		

For use.—To one ounce of A add sixty drops of B. When sufficient density is got, the plate must be well washed.

218. **Intensification of fogged negatives.**—When a negative is not only weak, but is also fogged, any attempt to intensify it without previous preparation would only make it worse. The fog must first be cleared off by applying a suitable reducer, and, after *thorough* washing, the plate may then be intensified by either of the above processes.

219. *Reduction of over-intensified negatives.*—Negatives which have been intensified by a mercury process may, if necessary, be re-immersed in the bleaching bath, and after washing may be blackened with a less energetic reagent; or any of the ordinary reducers may be used.

REDUCERS.

220. **Mechanical reducer.**—When only certain parts of the negative have to be reduced it may be done with methylated spirit. Put a piece of soft washleather over the finger, or over a stump such as is used by artists. *Slightly* moisten it with strong spirit, and carefully work it over the parts to be reduced. The negative should be dry. A little French chalk (powdered mica) considerably hastens the process, but powdered pumice or cuttle fish are generally too gritty.

221. **Ferricyanide reducer.**—This may be used either for general or partial reduction. Howard Farmer's formula is:

No. 25.—Ferricyanide reducer.

A.		B.	
Ferricyanide of potassium	20 grains.	Hyposulphite of soda ...	1 ounce.
Water	1 ounce.	Water	20 ounces.

To enough of B to cover the negative when laid in a dish add a few drops of A. Reduction commences immediately, and proceeds slowly. It is better to have but little of A present, else reduction will take place too quickly. Watch the reduction most carefully, and when sufficiently reduced, remove the plate immediately from the solution, and wash thoroughly. Throw away what remains of the mixed solution, which will not keep.

If too much ferricyanide is used a yellow stain is apt to result, which, to a great extent, nullifies the reduction, and Mr. R. Whiting recommends that when reduction is to be carried to any great extent the solution of ferricyanide and hypo should be rendered thoroughly alkaline with ammonia, to prevent the negative turning yellow.

222. **Ferri-perchloride reducer.**—The following is the recipe for this reducer:

No. 26.—Perchloride of iron reducer. (Cowan's.)

Ferri-perchloride, B.P	2 drams.
Hydrochloric acid	4 „
Water to make	20 ounces.

For slight reduction, wash the negative for a few minutes after fixing, then pour some of the above into a dish, immerse the plate for a minute, wash, *and immerse in the fixing bath.* For greater reduction just remove the excess of hypo after fixing, and apply as above. With hypo it is a powerful reducer.

223. **Haddon's reducer.**—When using any reducer containing hypo, or one after which the plate has to be placed in the hypo bath, prolonged washing is, of course, necessary. The following formula, into the composition of which hypo does not enter, is therefore a favourite one.

No. 27.—Haddon's reducer.

Potassium ferricyanide	5 grains.	Where only slight reduction is needed, the proportion of ferricyanide may be reduced.
Ammonium sulphocyanide ...	10 „	
Water	1 ounce.	

When ferricyanide of potash has been kept some time the surface of the crystals will have oxidised into ferrocyanide. It is well, therefore, when preparing the solution to put the ferricyanide into the bottle, add a little cold water and rapidly swill it round to wash off any ferrocyanide, throw away the washing, and then dissolve with the other ingredient.

The negative is first washed to free it from hypo, and if it has been dried, it must be first well soaked in water. After reducing, only moderate washing is required. The solution will keep some time.

224. **Belitzki's reducer.**—Make up the following solution:

No. 28.—Belitzki's reducer.

Potassium ferric-oxalate	200 grains.
Sodium sulphite	200 „
Oxalic acid (crystallised)	75 „
Distilled water	5 ounces.

Dissolve the iron salt, then add the sulphite, and, lastly, the oxalic acid; shake, and as soon as the solution turns green pour off from any undissolved acid, and add sodium hyposulphite two and a quarter ounces, and water to make ten ounces in all.

The negative is just rinsed as it comes from the fixing bath, and then immersed in the solution till *nearly* reduced enough, as a slight reduction continues during the subsequent washing, which must be done thoroughly. Dried negatives must be first soaked.

225. *Local reduction* may be done with a sponge or camel-hair brush. If the part needs to be reduced with a sharp outline, paint the reducer on the required part of the *dry* negative, and when it has acted sufficiently wash thoroughly. Or a little of the reducer may be mixed with thick glycerine and a drop or two of ammonia, and applied to the dry negative. If a soft outline is required, make the film *damp* (but not *wet*) before applying the reducer.

CHAPTER X.

PREPARING NEGATIVES FOR PRINTING.

226. It will be found that many negatives may be greatly benefited by judicious treatment.

What is ordinarily known as retouching, that is, the manipulation of the negative by a lead pencil, is not generally applicable to landscape work. It is also too large a subject to be handled here, special treatises must be consulted.

Inasmuch as the landscape photographer cannot always choose absolutely the best time or light for taking his pictures, he may use all legitimate means to modify harsh contrasts or subdue too prominent features. and this is generally effected by the application of non-actinic or light-obstructing media to portions of the back of the negative. The sky may happen to be so weak that it would print through, and so render the use of a separate cloud negative impossible; or the peculiar direction of the light at the time the negative was taken may have had the effect of causing undesirable patches of too high lights or too heavy shadows, which it is desirable to subdue; or, in interiors, the lighting may be uneven and harsh

Most of these imperfections can, either wholly or partially, be remedied by the methods explained below.

227. The various processes may be summarised as follow:

On the back *of the negative—*

Blocking out with cold mat varnish, coloured red.
,, ,, collodion ,,
,, ,, oil-paint.
Shielding the negative in parts whilst printing.

On the film *side of the negative—*

Touching out transparent defects with Indian ink or sepia.
Removing opaque spots.

There are other processes, such as backing the negative with tissue or mineral paper, but they are less simple than those above enumerated, and need not, therefore, be described.

228. **Coloured varnish.**—Mat varnish, coloured red, can be used cold, and can be worked upon, in places which require it, with a stump and finely-powdered blacklead. A formula for this varnish is given at para. 376. Any excess of varnish on parts not requiring it can be removed with a rag moistened with equal parts of alcohol and ammonia, those portions quite close to the outlines being scraped away with a penknife. This preparation is exceedingly convenient, and may be made of different shades of colour to suit various negatives by adding more or less of the colouring ingredient.

I have found it difficult to get a thoroughly suitable dye for colouring mat varnish, the solvent of which is mixed ether and benzole. Alkanet is the best of many tried. Aniline dyes are almost insoluble in benzole.

229. **Collodion and aurine.**—Mix equal parts of plain collodion and mat varnish, and colour with a saturated solution of aurine in alcohol, until the required tint is obtained. Flow this over the glass side of those portions of the plate which require it, and remove the surplus with a penknife or a small paper stump, leaving a rough edge. Any large excess may be taken off with a damp cloth.

What is called leather collodion is collodion with four per cent. of castor oil added; it is tough and well suited for this process.

230. **Paint.**—Take a tube of ultramarine blue, or red or yellow oil-colour, and a tube of "medium," squeeze a little of each into a saucer, and mix well together, then absorb the colour with a piece of soft rag or sponge; take up a very little at a time, by applying the point of the finger to the paint-saturated rag or sponge, and dab it on the glass side of the negative carefully and equally. When dry, repeat if necessary. Any portions may be removed with a bit of rag moistened with turpentine, or with a camel-hair brush dipped in benzole.

Brunswick black is used for completely blocking out portions of the negative in composition printing, and is laid on with a brush.

231. The processes descrbed in paras. 228-9 are not, of course, applicable to *films*, as most of these dry with a slight curl, which would prevent the varnish, etc., from being flowed over them evenly. Mineral paper may, therefore, be pasted over the back of the film and removed from those parts which require to be reinforced, and the paper may also be additionally worked on with a stump and finely-powdered blacklead.

I have also tried intensifying the whole film negative with uranium, and subsequently removing the intensifier with a dilute solution of ammonia from the portions which needed strengthening. This is a very neat process if well done, but there is a little difficulty in judging of the amount of intensification to be given. In the event of failure, however, the uranium may readily be removed either in whole or in part with dilute ammonia.

232. There are other plans for subduing the excessive contrast of a very harsh negative.

(a) Take a *faint* print on gelatino-chloride paper from the negative, fix and wash it (it need not be toned, and must not be alumed). When *quite dry* slightly damp the *gelatine face only* and squeegee it on to a sheet of glass the same size as the negative, to which it is to be applied as a shield while printing.

(b) Or a faint positive may be made from the negative on an ordinary photographic plate, and put first into the printing frame (film outward), and the negative on it (film upward), the two being carefully registered.

(c) Or a light print may be made on carbon tissue, and used in the same way.

(d.) The negative may also be dyed by one of the aniline dyes, blue-green being the best. The dye, according to Mr. Birt Acres, attacks the transparent more than the dense parts of the negative, and so softens the contrasts.

233. **Shielding the negative.**—The advantages of the foregoing processes are that the negative requires no special looking after whilst printing.

But when these plans are inconvenient, portions of the negative may be shielded by laying a sheet of cotton wadding over the printing frame, the edges being gently teazed out; all but the edge of the cotton wool should be covered with a focussing cloth or card to prevent the light acting on parts where it is not required. Or a mask may be made by taking an untoned but fixed print of the picture (preferably on *mat* paper), and cutting out from it the parts which require extra printing. The mask is then slightly moistened with water, placed on the glass side of the negative, to which it will adhere. The printing frame is then to be laid down flat in a subdued light, and the mask removed when the parts have been sufficiently subdued, and the print finished without further shielding, but the mask is apt to leave a harsh line unless kept on only for a very short time.

A better print may be obtained from a weak negative by covering the front of the printing frame with a sheet of tissue paper, or printing under green glass.

234. **Spotting the negative.**—Small *transparent* defects may be remedied by touching the negative on the film side with thick water colour laid on with a stiff red sable brush. For spots in the sky, Indian ink or sepia, or any opaque colour, will do, but for other parts of the negative a transparent colour, such as Payne's grey, is to be preferred. The colour must not be too liquid or it will dry in a ring; it should be consistent enough just to work, and care must be taken not to allow the pigment to extend beyond the limits of the defect, or the remedy will be worse than the disease. The colour should be stippled rather than washed in. The brush should not be moistened with saliva. Cake colours will be found preferable to moist colours, as the latter contain glycerine or honey, and do not dry as thoroughly as the hard colours.

Mr. Gulliver recommends very finely-powdered gamboge mixed with spirits of wine and a trace of turpentine applied with a stiff sable brush; the spotting dries instantly.

Spotting is best done after the negative has been varnished, because if the first attempt is unsatisfactory it may be rubbed off and the operation repeated.

The best way to remedy *opaque* spots when they are numerous and the negative is sufficiently valuable is to make a transparency from the negative; in this the opaque spots will have become transparent, and can be easily touched out, and a fresh negative then made from the transparency.

235. Spotting must be done on a retouching desk, and it is well to have "a little front light on the negative, in addition to that transmitted through it; this enables the worker to see better not to overlap the lines," and a pair of strong spectacles will facilitate the work. The light should be reflected from a sheet of white paper or cardboard, and must not be too strong. Spotting is a difficult thing to do well, and the novice will be wise to get a few lessons from a professional retoucher.

For retouching *portraits* special pencils, free from grit and capable of being brought to a very fine point, are necessary. Those by Hardmuth seem generally preferred.

CHAPTER XI.—PRINTING PAPERS.

236. **Various printing papers described.**—As it is desirable, whenever possible, to suit the paper to the quality of the negative, a few of the numerous kinds of sensitised paper in general use may here be enumerated.

Development Papers.	Platinotype paper. Bromide (gelatino-bromide) paper. Transferotype paper. Carbon paper.
Print-out Papers.	Gelatino-chloride paper (glazed and mat surface). Collodio-chloride paper. Albumenised paper. Salted paper (called also " Mat " paper). Ferro-prussiate (cyanotype) paper and its varieties. Print-out platinum paper.

237. **Platinotype paper.**—This paper is generally considered to give the most artistic results of all the printing processes. It is also the easiest and quickest, for by it prints can be completed in a couple of hours, and it is undoubtedly permanent.

There are two varieties of platinotype paper, viz., the original kind, suitable for *hot* development, and that more recently introduced, called "cold-bath paper." The latter is generally preferable, especially for amateurs.

238. **Bromide paper.**—This paper differs from all others in that it can be worked by artificial light, and is therefore useful in the dull days of winter, when other printing is excessively slow. It is also convenient for those who are otherwise occupied during the day, and whose only leisure is during the evening.

The working of this paper has been so much improved of late years, and the tones now obtained on it are so good, that it competes very closely with platinotype for the first place amongst printing processes.

Ordinary bromide paper has a mat surface, which is considered by most to be one of its advantages. It is prepared in two qualities, viz., "rapid" and "slow." The *slow* paper should be used for *contact* printing, as, by varying the exposure, either warm or black tones can be obtained. The rapid paper is best for enlargements in the camera, and with it black tones are generally got. To meet the desire for highly-glazed surfaces, the Nikko paper has been introduced. It is worked in the same way as the mat surface bromide.

There are many brands of bromide papers in the market, most of them of good quality, and new kinds are still being introduced.

239. **Transferotype paper.**—This is also a bromide paper, but is so prepared that the picture, after being finished, can be subsequently transferred to glass, opal, or any surface that will withstand the action of hot water. It is treated like ordinary bromide up to the final transferring process, for which instructions are given by the Eastman Company.

Transferotypes printed by contact in the ordinary way, and subsequently transferred, will be *reversed*. When this is not desired, the print must be made like an enlargement by exposure in the camera, the negative itself being reversed in its holder. The reversed print thus obtained will come right when transferred. Negatives on thin roller films, which can be printed from the back, produce prints suitable for transfer.

240. **Carbon paper.**—For a long time this excellent paper was not much used by amateurs, chiefly because of the supposed difficulty of the process. There is now, however, a marked revival in its favour. It is quite as simple as any of the other printing processes, though prints which have to be produced by the double transfer may require somewhat more labour. The results are very good, and are considered to be permanent.

The paper does not keep long after being sensitised, and should therefore be got fresh from the makers when required for use.

241. **Gelatino-chloride paper.**—It is now generally acknowledged that this paper does greater justice to the fine details of a negative than any other, and that it will make a passable print from a negative which is too weak for most other printing processes. It is somewhat more expensive, and requires more careful manipulation than albumenised or salted papers, but the results are remarkably good. It does not need much overprinting. It is prepared either with a highly-glazed or a dull (mat) surface.

242. **Collodio-chloride paper** is much employed in America, and is coming into more general use in England. It is capable of yielding very good results, and its good keeping qualities make it especially valuable in hot and damp climates.

243. **Albumenised paper.**—This is still popular, though it is being largely superseded by gelatino-chloride paper. It may be had in two qualities, viz., "single" or "double" albumenised, the latter having a more highly-glazed surface. It yields good results from all but very weak negatives, and must be printed rather deeply.

244. **Ordinary salted paper.**—This paper is preferred by those who object to the glaze of the ordinary albumenised paper. It is best suited for large and vigorous negatives. It requires to be very deeply printed, as it loses considerably during toning and fixing, but it tones quicker, and darker tints are more readily obtained on it from suitable negatives than on albumenised paper. It answers well for making proofs; these, when deeply printed in the sun *under green glass*, and *fixed without toning*, are of a very pleasant dark brown tint. If the green glass is omitted, the untoned prints are reddish-brown in colour.

It must, however, be always remembered that satisfactory results with salted paper cannot be expected except with *strong, brilliant, almost hard negatives*. With the ordinary soft negatives which are best suited for most other processes, salted paper gives only comparatively flat and mealy prints; and with weak negatives it is absolutely useless.

Mr. G. H. Moss gives the following formula for plain salted paper:

No. 29.—Sensitisers for salted paper.

A		B	
Ammonium chloride ...	100 grains.	Nitrate of silver	400 grains.
Common salt (crystallised)	150 „	Citric acid	150 „
Potassium bichromate ...	4 „	Water...	10 ounces
Water	20 ounces.		

Immerse Whatman or Rives paper for three to five minutes in solution A, and after drying float for two minutes on solution B. Col. Waterhouse says this paper keeps well after sensitising in India.

245. **Rough salted paper.**—Pictures of *large* size may be effectively printed on rough surface drawing paper, Whatman's make being very suitable. Mr. T. O. Mawson gives the following formulæ, but rough salted paper can be procured from many dealers:

No. 30.—Salting solution for rough paper.

Arrowroot	180 grains.
Chloride of ammonium	160 „
Water	20 ounces.

Make the arrowroot into a paste with eighteen ounces of the water, and when sufficiently cooled add the chloride of ammonium dissolved in the remaining two ounces of water. Let it stand all night, then pour off the clear portion into a suitable dish, float the paper on it for three minutes, and after removal from the bath, lay the paper, face downwards, on a level table to allow it to absorb the solution; this prevents irregularity in silvering. Hang up to dry, marking the back or unsalted side with pencil.

No. 31.—Sensitising bath for rough paper.

A.		B.	
Silver nitrate	60 grains.	Citric acid	25 grains.
Water	½ ounce.	Water	½ ounce.

These solutions are made separately and mixed. Float the salted paper on the bath for three minutes, avoiding air-bubbles, and hang up by a *wooden* clip to dry. This paper will not keep very long after being sensitised.

Mr. Blanchard is of opinion that both the salting and sensitising solutions must penetrate the paper considerably in order to produce sufficient force in the finished prints; and, before toning, the free silver must be thoroughly washed out, as upon its thorough removal the permanency of the print depends. To ensure this, the last washing bath before toning should be of strong salt and water. Salted paper requires to be printed and toned strongly.

246. **Print-out platinum paper.**—This paper when in the printing frame shows clearly all but the finest details; it requires no development, but only needs to be fixed in acidulated water. The tones are generally warmer than those of ordinary platinotype paper—see para. 299.

247. **Ferro-prussiate paper.**—This is exceedingly convenient for taking proofs of negatives, as it only needs washing in water after it comes from the printing frame. It is much used by professional machinists and others for multiplying plans, etc., and may be readily home-made.

There are three varieties of the process, viz., the *white line* process, the *blue line* process, and the *black line* process; that is, the papers so designated produce lines of these colours when printed under an engineer's or architect's drawing on paper or tracing cloth, which drawing, it must be remembered, is a *positive* when considered photographically. The same papers printed under a photographic *negative* would *give exactly reversed colours*, and, consequently, the paper for the first process is the only one of any use to the photographer, except when wishing to copy an engraving or other print in black and white; the black line paper would then serve.

The difficulty of keeping ordinary silver paper in moist tropical climates is so great, and the preparation of the ferro-prussiate paper is so simple, that I here give a formula. In England it is, of course, better to purchase it as required.

A good dense paper, well sized with *starch* or albumen, such as plain Rives paper, is necessary; gelatine sized paper is unsuitable. The sensitising solution is prepared as follows:

No. 32.—Ferro-prussiate bath

A.	
Citrate of iron and ammonia	1⅞ ounces.
Water	8 "

B.	
Ferricyanide of potassium ..	1¼ ounces.
Water	8 "

For use.—Mix equal volumes of the two solutions, and apply the mixture to the paper quickly in the dark room, by means of a Buckle's brush* or soft sponge, going over the paper first from left to right, and then from top to bottom. The dark room should be as warm as possible, so that the paper may *dry rapidly*. The paper must not be floated, or the solution will penetrate it, and the prints will be without brilliancy. If one grain of potassium bichromate is added to every two ounces of the mixed solution, the printing qualities of the paper remain intact for from three to five months.

248. Mr. Latimer says that the addition of a saturated solution of oxalic acid to the ferro-prussiate bath, in the proportion of from ten to thirty per cent., greatly hastens the printing, especially in cloudy weather. When ferro-prussiate prints are found, after washing, to be of a dirty green colour, they should be immersed in a solution of oxalic acid (one to thirty), which will, in four or five minutes, restore the proper blue tint; they must then be again washed.

Ferro-prussiate paper will not print satisfactorily if kept too long, and is best preserved in a calcium tube.

249. **Papers suited for specified negatives.**—To recapitulate the substance of the foregoing remarks:

For a perfect negative of good strength and gradation any paper may be used. Gelatino-chloride gives the finest details; the tone of platinotype is considered most artistic; whilst the albumenised and bromide papers have each their adherents.

For a dense negative, plain salted paper.

For a thin negative, gelatino-chloride or bromide. When these papers are not available, albumenised paper, printed in the sun under green glass, may be used.

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* Buckle's brush is made by folding a piece of white cotton flannel over a strip of glass and securing the ends with a rubber band.

CHAPTER XII.—PRINTING.

250. More money is wasted on unsuccessful printing than on all the other photographic operations combined. The operator is often reluctant to condemn a negative which he feels to be not altogether satisfactory, but will not hesitate to expend several pieces of sensitive paper in the vain hope of getting a good print from it. He seems to forget that the ordinary half-plate negative does not cost much more than 2½d., whilst *each* piece of sensitised paper which he so lavishly uses on "trials" costs on an average (including toning, etc.) quite half that amount; his three or four unsuccessful prints have, therefore, cost him double the value of the original negative. It is best, on the score of economy as well as of art, to ruthlessly destroy every negative which does not come *fully* up to the mark, and then to print only by the best processes and with the utmost care

251. Before describing the modes of manipulating the different kinds of paper, a few notes, generally applicable to all processes, are here given.

Hard negatives.—As printing in a bright light reduces contrast, hard negatives should be printed in direct sunlight.

Ordinary negatives.—Printing in subdued light increases contrast. Ordinary negatives should, therefore, be printed in the shade.

Weak negatives.—Very weak negatives are improved by printing under green glass in full sunlight. When green glass is not used, weak negatives should not be laid down to face the light in the ordinary way, but should be stood on edge in the quietest light that can be found.

It cannot be too often repeated that the quality of the final print depends almost entirely on the *quality of the negative.* The selection of a suitable kind of paper has some effect, and with silver papers a proper toning bath also contributes towards the final result, but a really good print *cannot* be got from an inferior negative, whatever the process used.

PLATINOTYPE.

252. **Cold bath platinotype.**—The following remarks on the manipulation of platinotype paper are largely drawn from the pamphlet of instructions issued by the Platinotype Company. The "cold bath" process is now most generally used, and is the one here described.

Keeping the paper.—The paper is sent out in hermetically sealed tins, in each of which is also enclosed a lump of chloride of calcium to secure perfect dryness. When required for use, the tins should be opened and the paper transferred to special chloride of calcium tubes having a cell at the bottom for the reception of calcium chloride. These precautions show the absolute necessity of keeping the paper *at all times* perfectly dry. The chloride of calcium in the tubes should be looked at occasionally, and if found at all moist should be thoroughly dried over the fire, or replaced with a fresh supply.

The paper keeps in good order for several months, and improves by being kept a few weeks after manufacture. It should be obtained *direct* from the makers, and each tube will be found to bear on the label the date of sensitising.

It is said that platinotype paper that has been kept too long, and is considered to be spoilt, may be renewed by being put in a fairly hot oven for an hour or two before use.

Printing.—The paper should be transferred from the tube to the printing frame as rapidly as possible, as it is very sensitive to light, and the tube should be *immediately* re-closed. A thin sheet of rubber (sold for the purpose) should be placed on the paper in the printing frame, and any additional pads that may be needed should be *quite dry.* Sheets of celluloid are by some preferred to the rubber.

A *strong, bright diffused light* is best for platinum printing; printing in sunlight should, as a rule, be avoided. Abney points out "that the same results do not obtain with platinum paper as with silver—that is to say, hard negatives gain nothing by being printed in sunlight, and feeble ones in subdued light do not gain in value." During the printing the yellow tint of the sensitive surface becomes of a greyish-brown colour, and, as a general rule, all except the finest details of the picture should be brought out. The exact depth to which the paper should be printed will be seen after a few trials. The image of a fully printed proof is so comparatively faint that care must be taken not to over-expose. As, however, the development is more under control than in the hot bath process, a slightly over-exposed print may be saved.

The prints should be rapidly examined from time to time in subdued light, to which they should not be unduly exposed, "for the degradation of the whites of the paper, due to *slight* action of light, is *not visible until after development.*"

If the prints are not to be immediately developed they should be returned to a calcium tube, but it is better, as a rule, to finish them at once, so that any errors of exposure may be corrected in subsequent prints.

253. *Development* should be done in subdued daylight or by gaslight.

No. 33.—Stock developer for cold bath platinum paper.

Potassium oxalate (neutral))	16 ounces.
Water	54 ,,

If this bath is made *slightly* alkaline the tones will be warmer, but "alkali" should on no account be added in larger quantities than is just sufficient to turn red litmus paper a faint blue. Ammonia is unsuitable, but carbonate of soda or of potash may be used.

If made slightly acid, the bath will give colder tones than if neutral.

For ordinary use.—Take one part of the stock developer and two parts water, but have also at hand a small dish of the *undiluted stock solution,* to be used for under-exposed prints, as explained below.

Paper which has been kept for, say, two months from date of manufacture is preferably developed in a more dilute bath (stock developer 1 part, water 6 or 7 parts).

It must be remembered that these dilute developers deteriorate quickly, and if, after a certain number of prints have been passed through them, defective development is observed, the solution should be thrown away, and a fresh one prepared. Used solutions should not be kept.

The bath should be rocked or stirred after each development, to break up any scum which may have been left by the previous print.

The paper should be *floated* on the developer in the usual way, the greatest care being taken to avoid air bubbles. This may generally be done by laying one edge of the print upon the solution near the right-hand end of the dish; then, with a sliding motion towards the left, lower the print with an even movement without stoppage until it is entirely in contact with the liquid. After resting on the solution for a few seconds, the print should be taken out and held in the hand, face upwards, and the development carefully watched, any air bells being rapidly touched with the finger moistened with a little of the developer. If the print does not develop to the required depth whilst held in the hand, float it once more on the developer; or, if much *under-exposed*, transfer it to the dish of undiluted stock solution, taking it again into the hand to watch it, and remembering that the print after drying will be a shade or two darker than it appears during development.

When the right effect has been produced, transfer the print immediately, face downwards, to the acid fixing bath (without previous washing).

If a platinum print has been accidentally so much over-exposed that all the details are out, it may be at once fixed in an acid bath without previous development.

Fixing.—This is done in a series of three baths of dilute hydrochloric acid (acid 1 part, water 60 parts). The acid should be pure. (A citric acid bath—acid 1 part, water 20 parts—may be substituted if necessary.) In the first bath the greater part of the unacted-on chemicals in the paper is dissolved. After remaining in this, *face downwards*, for five minutes, the print is transferred to the second bath for about ten minutes, then to the third bath for fifteen minutes, and lastly to the washing water. Whilst in these baths the prints should be occasionally moved to ensure equal action. The baths should be kept in separate bottles, numbered 1, 2, and 3, and always used in the same order. When the first bath has become surcharged with chemicals, it should be thrown away, the second bath then becomes No. 1, the third No. 2, and a new bath is made up for No. 3. The makers' instructions prescribe fresh acid baths for each batch of prints, but when working only a few prints at a time I have not found this precaution necessary.

The prints should not communicate the faintest tinge of colour to the last acid bath. "If the bath does not remain as colourless as water when a depth of fully two inches is viewed in full daylight, the prints should have yet another acid bath."

Washing for about a quarter of an hour in three changes of water is sufficient. A pinch of washing soda should be added to the second washing water to neutralise any acid remaining in the prints. If there is much lime in the water, this will throw down on them a white deposit, which can, however, be completely removed with a dry, soft rag when the prints are dry. By keeping the prints face downwards, the deposit does not adhere so readily, and it may be entirely prevented by using soft or rain water. Water containing iron should not be used.

Platinum prints may be toned with uranium in the same way as bromide prints.

254. *Brush development.*—Prints up to half-plate size may be easily developed with a "mop" camel-hair brush. The print should be laid on a sheet of glass* and the brush, moistened in the developer, should be rapidly passed across the face of the print, commencing at the top, and wetting the brush after each stroke. Each succeeding stroke should overlap the previous one, and the strokes should follow each other as rapidly as possible. When the print is wetted all over, the liquid should be equalised with the brush, which need not now be replenished with fresh solution. Insensitive parts may be carefully touched with a smaller brush and a little of the *undiluted* stock developer.

255. *Development with glycerine.*—Make the following stock solution:

No. 34.—Stock glycerine-oxalate developer.

Stock developer (No. 33)	1 part.
Pure glycerine	1 "

For use.—Take one part of the above solution and mix with one or two parts of water. Pour a little of this into a cup and apply with a brush as described above. Other ways in which glycerine may be used in development are given in the pamphlet of instructions issued by the Platinotype Company.

Care should be taken to use a *pure* sample of glycerine; much of that sold is often contaminated with citric or other acid, which would spoil the developer.

256. When printing clouds on platinotype paper, the impression required to be made is so slight that it is not visible on the print before development. Most operators endeavour to print in their skies in diffused light of unvarying intensity, and to time the process with the watch. For printing from cloud negatives in weak diffused light, from five to seven minutes are found to be required, but this may need modifying to suit other conditions. A good actinometer is a valuable guide.

As a rule it is best to print the sky *first*, and the landscape afterwards.

257. *Spotting.*—One of the numerous advantages of platinum paper is the facility with which defects in the prints can be remedied. This may be readily done, even by the inexperienced operator, with a camel-hair brush and dilute Indian ink.

BROMIDE PRINTING.

258. An ordinary soft negative with good gradation and abundant detail very suitable for bromide printing, and excellent prints may be obtained om comparatively weak negatives, provided there is ample detail. A ard negative is unsuitable.

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* If a little glycerine is first smeared over the glass, and the print then pressed on it, it ill remain flat.

The printing frame is exposed to the light of an oil lamp or gas burner, a sheet of frosted glass, or a frosted or opal globe, being interposed to diffuse the light evenly. The distance from the lamp is generally from two to three feet, but may be altered according to the tones required.

A weak negative should be placed farther from the light, and a strong negative closer, it being remembered that doubling the distance of a negative quadruples the exposure required. Very weak negatives may be printed under green glass, but will require about fifteen times the normal exposure.

For light tones give a long exposure, and make the developer weak in iron. For dark tones give a comparatively short exposure, and make the developer strong in iron and bromide.

Under-exposure gives chalky and sooty prints; over-exposure or alkaline oxalate gives flat, grey prints, and a tendency to fog.

For ordinary bromide printing the best plan is to give a comparatively long exposure, and use a developer weak in iron, and with somewhat more bromide than is generally prescribed; but as the addition of bromide to the developer markedly increases contrast in this process, it should be added with caution.

Bromide prints may be taken from *wet negatives*. On this subject Mr. Burton says: "The fact has been published, but we do not believe it is generally known, that bromide prints may be taken from negatives that have not been fixed or even dried. It has been stated that this method is used in getting ready pictures for the illustrated press when an artist has to copy or draw from a photograph. The negative is developed, is either pretty thoroughly washed, or is treated with a bromide solution, and fairly well washed, when a piece of bromide paper is soaked in water, and is squeegeed into contact with the film of the negative. An exposure is then given (by artificial light) several times greater than would be necessary with a fixed negative, depending on the density of the film, and the print is developed. The necessary exposure of the negative to gas, lamp, or candle light does not do it the slightest harm."—*Photography*, 1893.

259. **Exposure book.**—It will be found very convenient to keep a record of all negatives printed, showing (1) date; (2) the subject; (3) quality and number of negative; (4) the light used; (5) the distance of the printing frame from the light; (6) the exposure; (7) the brand of paper; (8) the developer used; and (9) the result.

260. *Ferrous-oxalate developer.*—There are numerous minute variations in the formulæ for this developer, but for practical purposes they all work alike.

No. 35.—Ferrous-oxalate developer.

A.			B.		
Potassium oxalate ...	16	ounces.	Iron protosulphate ...	4	ounces.
Acetic acid	3	drams.	*Sulphuric acid	9	minims.
Hot water	64	ounces.	*Hot* water	12	ounces.
C.			D. *(clearing solution).*		
Potassium bromide ...	¼	ounce.	Acetic acid	½	ounce.
Water	2½	ounces.	Water...	80	ounces.
(a ten p.c. sol.)					

For use.—The developer *should be modified to suit the exposure, as in the case of a gelatine negative.* For varying exposures and different tones the following proportions may be used, and they may be varied indefinitely between the two extremes to meet different requirements.

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* Sixty grains of citric acid may be used instead of the sulphuric acid, if the latter is not available.

For long exposures and light tones.	Oxalate solution	12 drams.
	Iron	1 dram.
	Bromide	3 drops.
For short exposures and black tones.	Oxalate solution	12 drams.
	Iron	3 „
	Bromide	1 drop.

Old developer, renovated just before use with a portion freshly mixed, works more evenly than new, and gives more brilliant prints. Water must not be added to the mixed developer, or the iron will be deposited.

Development with ferrous oxalate is done as follows: After exposure, soak the paper thoroughly in clean *soft* water; if hard water which contains lime is used to soak the prints before development, a precipitate is thrown down on them immediately the developer is added, and though this does not affect the ultimate quality of the picture, and is dissolved off in the acid bath, it temporarily obscures the development and prevents its progress being clearly seen. The dish should be without the usual ribs. Then make up the developer, adding the iron to the oxalate, and not *vice versâ*, or a precipitate will be formed.

Pour off the water, and pour on the developer, rocking the dish steadily. When the image appears, and its quality can be judged of, the developer may be modified if necessary. If the picture flashes out too rapidly, pour off the developer, and flood the print with water. Meanwhile add more bromide to the developer, throw off the water, and re-apply the modified solution.

It must be remembered that the finished print will be *darker* than it looks when in the developer; allowance must therefore be made, and the development not carried too far.

After development, and *without washing,* immerse the print in the clearing solution, which should be freshly prepared for each batch of prints, and should not be stinted in quantity. "When a developer unusually strong in iron is used, a yellow coloration of the picture is apt to take place in spite of the acid bath, and this occurs more frequently with hard films, which wash slowly. In such cases an increase of the acid to double or treble its quantity in the first water will help, but if this is not sufficient, the picture should first be put in a pure oxalate solution, left for a few minutes therein, and then washed with weakly acidified water."

After each print has remained in the clearing solution for a few minutes, transfer it to a large covered basin of water, and let it remain there with occasional changes of water till the whole batch is developed. Then wash the whole *thoroughly* with several additional changes of water, until all the acid has been eliminated, as, unless it is entirely removed, sulphur will be generated in the fixing bath, and the permanency of the prints imperilled.

When the batch of prints has been *thoroughly* washed as above, transfer the prints one by one to the fixing bath (one hypo to five water), and let them remain in it for ten minutes, or until they are quite translucent. Then wash thoroughly. Or the *acid fixing bath* (No. 16) may be used, and the intermediate clearing bath dispensed with.

Nikko and Alpha papers are treated in the same way as ordinary bromide paper, and the former is finally squeegeed down on ferrotype plates or glass to obtain a glazed surface. Alpha paper is very slow, and after development has to be toned in a gold bath.

261. *Other developers.*—Good results may be obtained from bromide paper with the quinol, eikonogen, amidol, metol, or other similar developers, prepared according to the formulæ given under each. Amidol seems to be the one generally preferred; formula No. 7, para. 161, is a good one. The following metol developer is recommended by J. Fuerst for bromide work:

No. 36. - Metol developer for bromide.

A.		B.	
Potassium metabisulphite	1 ounce.	Potassium carbonate ...	3¼ ounces.
Metol	150 grains.	Sodium sulphite	3¼ ,,
Water	10 ounces.	Water	17 ,,

For use.—Mix one part of A, one part of B, and from ten to twenty parts of water. Metol is readily restrainable by bromide of potash, and a few drops added to the above developer will clear any surface fog.

The mixed quinol and metol developer (No. 14) is also excellent for bromide work.

Many workers find it best to dilute the ordinary formulæ when using them for bromide prints, and this is especially the case when soft grey tones are required. It must be remembered that prints treated in these developers lose perceptibly when fixing, also that *thorough* washing before fixing is essential.

The acetic acid clearing bath is not required with these developers, and this is no small gain, for the labour of washing the acid from ferrous-oxalate prints before transfer to the fixing bath is considerable, and if it is shirked the prints will almost certainly fade.

262. **Toning bromide prints.**—After the prints have been fixed and washed, Mr. Talbot obtains warm red tones with the following bath:

No. 37.—Toning bath for bromide paper.

A.		B.	
Ferricyanide of potash...	77 grains.	Uranium nitrate	77 grains.
Water	17½ ounces.	Water...	17½ ounces.

To be mixed in equal parts just before use. The print is toned in this, and then *thoroughly* washed and placed once more in the fixing bath (hypo 1, water 5) for five minutes, and well washed again. Prints developed with ferrous oxalate are not well suited for uranium toning, because if a trace of iron is left in the paper, blue stains will be produced.

Mr. J. Weir Brown recommends a modification of the above, consisting of ferricyanide of potash 4 grains, uranium nitrate 4 grains, glacial acetic acid 90 minims, water 8 ounces.

263. *General instructions for bromide printing.*—In very hot weather it is desirable to soak bromide prints, after fixing, in a plain solution of alum (no other chemical being added), and it is important that the prints should have been *thoroughly* washed in several changes of water after the hypo, before putting them into the alum.

If blisters appear after fixing, they may be avoided by using a fixing bath not stronger than 1 to 7 or 8, allowing the prints to remain longer in it, or by immersing the prints after fixing (without previous washing) in a bath of common salt and water (1 to 10).

The utmost cleanliness is necessary when working bromide paper. The developing dish should be kept for this purpose only. The slightest trace of hypo or pyro will stain the prints.

"Development should be done in as strong a yellow light as the paper will stand, as it is impossible to judge when to stop development in a ruby light."

Over-printed pictures can be reduced by taking some of the ordinary fixing bath in a separate dish, and adding to it a few drops of a ten per cent. solution of ferricyanide of potassium. Fog and stains may be removed by a weak solution of cyanide of potash and iodine.

264. **Printing clouds in bromides.**—Cut a piece of moderately thick notepaper to the size of the *outside* opening of your printing frame. Then put the landscape negative into the frame (omitting the back), and push it up into one corner (and this must be done in all subsequent operations to ensure correct register). Hold the frame up to the light, supporting the negative on the back with the finger, and, having put the notepaper over the front of it, trace the outlines of the landscape in pencil, taking no heed of trifling projections above the skyline. Now cut out this mask a quarter of an inch below the horizon line, and gum some cotton wool along the margin to soften the edge. Mark carefully the *top* of the printing frame, and, taking it into the dark room, insert a suitable cloud negative, and on it a sensitive bromide paper. Put the mask on the front, and then expose it to the printing lamp. Return to the dark room, remove the cloud negative, insert the landscape negative, and give full normal exposure.

Clouds are best printed in a subdued light; if, therefore, the usual distance for printing your landscape is two feet from the lamp, allow four feet for printing the cloud, and give only one-eighth of the exposure usual at this distance.

The great thing is to remember which is the *top* of your printing frame and sensitive paper.

Owing to the tediousness of printing clouds in bromide prints in the way above described, Mr. Wheeler recommends that the skies of negatives for bromide printing be developed very thinly, and that suitable skies be afterwards painted in on the glass side with Payne's grey, and any harsh edges softened with the tip of the finger.

TRANSFEROTYPES.

265. The preliminary process for transferotypes is the same as that for ordinary bromides. When the prints are finished and dry, they are soaked again in cold water and placed on the opal, wood, or other substance to which it is desired to transfer them, the surface of which should be quite clean. The print is then squeegeed down and put under blotting paper and a weight till *quite dry*. Then pour hot water at 160° on the paper back until it blisters, lift a corner carefully, and peel off. Gently brush the surface of the picture with a camel-hair mop moistened with warm water, and stand in a warm room to dry.

CARBON PRINTING.

266. Direct prints by the carbon process are reversed. With many subjects this is of no consequence, but where this reversal interferes with the effectiveness of the resulting picture, reversed negatives must either be prepared, or the print must be made by the "double transfer" process.

Space will only admit of a description of the simplest process, viz., the "single transfer," and as of the variety of substances to which the print can be transferred opal is the easiest worked, and most effective when finished, it will be the one here treated of.

For other variations of the process, and for a description of the "double transfer," the reader is referred to the little treatise on the subject by Messrs. Elliott and Sons, from which pamphlet many of the following instructions have been derived.

The first thing to be done is to put a "safe edge" on the glass side of the negative. Procure a thin flat ruler or lath, tack on to each end a strip of wood sufficiently thick to carry the ruler clear of the negative. With this ruler as a guide, and a small camel-hair brush dipped in quick-drying black varnish, trace a black border about a quarter of an inch wide all round the negative. After a little practice this can be done very rapidly and evenly.

When the varnish is dry, put the negative in the printing frame, being careful to see that it is so placed that the safe edge is equidistant from the margin of the frame all round. In the dark room test the sheet of carbon paper with a negative of the size you are using, and if it is found to be larger than the plate cut the paper to the exact size. Now place the carbon paper, pigment side down, carefully on the negative, so that the edge of the paper and the edge of the negative may correspond all round. Then close the printing frame. These simple precautions will ensure a white margin *of equal breadth* all round the finished picture.

As the action of the light is not visible on the carbon paper some guide is necessary. Carbon paper having about the same sensitiveness as ordinary silver paper, a negative of the same density should be selected, and simultaneously printed under silver paper, and when the latter is sufficiently printed the carbon print will be done. As, however, it would not be convenient to do this on every occasion, an actinometer is necessary.

Whilst the picture is printing, prepare three dishes—one with cold water, the second with warm water at from 100° to 110°, and the third with a saturated solution of alum; also a ground opal plate which has been carefully scrubbed with a nail-brush and soap to remove every trace of grease, etc.

When the print is ready, remove the printing frame into subdued light, and transfer the print to the dish of cold water, pigmented side down, seeing that it is equally wetted all over, and removing any air-bells with the fingers. See also that it is at all times covered with water. The paper, when first put into the water, will probably curl slightly inwards; it will then gradually flatten out and begin to curl *upwards*. *Immediately* it *commences* to do this, take it out, and, without draining, lay it on the ground opal, taking care to place the print at once in its proper position, as it may not be shifted after once being in contact with the opal. Squeegee vigorously, lay a pad of blotting paper and a weight on it, and leave it for five minutes.

Then, having first tested the water in the dish, to see that it is of the right temperature (100° to 110°), transfer the opal to it, paper side uppermost. When it has been in for a short time, the pigmented gelatine will commence to ooze out between the opal and the paper, which latter may now be gently removed by taking hold of a corner and drawing it off. When the paper has been thus withdrawn, gently lave the print by taking hold of one end of the opal and moving it up and down in the warm water. The pigment which has not been acted on by the light will float away, and the picture will appear. When all details are out, transfer it to the dish of cold water, wash, and remove to the alum bath for a few minutes, after which rinse again in cold water and put in a rack to dry.

If the print has been over-exposed, somewhat hotter water may be necessary—if under-exposed, and the picture is found to be losing detail, transfer at once to cold water.

With every care, the white margins of the print will not always be quite straight. Take a flat ruler, and guarding the print itself with it, rub down the surplus and irregular edge with a piece of pumice stone.

GELATINO-CHLORIDE AND ALBUMENISED PAPER.

267. The modes of working gelatino-chloride and albumenised paper are so similar that they will be treated together, any slight variation from normal procedure required by either paper being noted as it occurs.

Keeping.—Both papers require to be kept *dry*, and this is especially the case with the gelatino-chloride paper, which is more hygroscopic than the albumenised.

The calcium tubes are the most efficient, especially when paper has to be kept a long time in hot and moist climates, but they are *not* essential in Europe.* The most *convenient* plan is to keep the paper in an old-fashioned printing frame with *deep* sides. A glass plate is first put in, then a pad of *quite dry* blotting (or preferably filtering) paper; then the sensitive paper, and lastly another pad of blotting paper. The cover being now put on and the springs fastened, the paper is kept quite flat and fairly air-tight, and is readily accessible.

Printing.—Both papers are printed in the usual way, but as the gelatino-chloride is more sensitive to light than ordinary albumenised paper, it should only be examined—during printing—in very subdued light.

With gelatino-chloride paper it is desirable to place a rubber pad behind the print in the printing frame.

A very strong diffused light is best for printing from ordinary negatives —see also para. 251.

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* When gelatino-chloride or albumenised paper is kept in calcium tubes it should be taken out an hour or two before required for printing, and laid out in the dark room to absorb the normal moisture of the atmosphere. It thus prints better than when used directly from the calcium tubes.

The amount of over-printing will much depend on the toning bath to be used, and will be soon ascertained by experience.

As each print is finished it should be placed in a light-tight box until the batch is completed. An empty plate box with well-fitting cover is suitable.

268. *Sunning down.*—When it has not been found convenient to prepare the negative by any of the means described in Chapter X., any harsh patches of white in a print may be subdued by exposing those portions of the *back* of the print to bright light, all the rest of the print being protected from the action of the light. If the sunning is done on the *face* of the print, a piece of tissue paper should be interposed, as the tint obtained by direct sunning differs in quality from that obtained through the negative.

269. **Washing before toning.**—This must be *thoroughly but quickly* done, the prints being put into the water, one by one, *face downwards*, each print being wetted all over before the next print is put in, for if the gelatine surfaces of two prints are allowed to come in contact before they are fully wetted, they will probably stick together and be spoiled. The first two or three changes of water should be poured away *quickly* so as to get rid of the soluble salts rapidly.

The washing should be done in subdued light, and the dish should be kept covered with a sheet of millboard; in short, light must be carefully kept from the prints throughout all the operations until finally fixed.

The water used for washing gelatino-chloride prints before toning must be *soft*. Hard water deposits a coating on the surface of the print, and obscures the toning.

An article in the *British Journal of Photography* (November, 1893) strongly recommends that after this preliminary washing the prints be immersed in a weak solution of common salt, and again *thoroughly* washed to remove the salt before transfer to the toning bath.

270. *Neutralising the acid in the paper.*—Most ready-sensitised paper is prevented from deteriorating by treatment with some acid. This acid must be removed, or the prints will not tone readily. A five per cent. solution of common washing soda should be kept for this purpose, and a few drams of it poured into the second washing water, but the soda must be fairly well washed out, for if much of it is allowed to remain the prints will tone very rapidly, but will lose greatly in the fixing bath.

271. **Reason for toning.**—Prints on albumenised and gelatino-chloride papers, if fixed as they are taken from the printing frame, yield anything but pleasing tints. They must therefore be toned, and this toning consists in the substitution of finely-divided gold (or platinum) for the silver of the print.

It must be always remembered that the perfection of the toning will depend more on the *quality of the negative* than on the particular toning bath used. With weak negatives good tones *cannot* be obtained with *any* toning bath.

272. **Light for toning.**—Weak daylight is generally preferred for toning, as some find it difficult to judge of the tones by artificial light. To secure evenness of tone in the prints, they should be examined by *transmitted* light. A mere inspection by direct light is most deceptive, as

the surface is toned long before the under deposit is affected, and it is to the deposit in the substance of the albumen or gelatine film that the richness of tone is mainly due.

273. Different baths affect papers differently, and the various papers behave differently in the same baths, but as a rough guide it may be considered that a print is fully toned when, on looking through it by transmitted light, the red colour of the original silver print is found to have disappeared, and to have been replaced by the darker deposit of gold.

Whilst under-toning should be avoided, over-toning is fatal to brilliancy, and produces flat and mealy prints. Gelatino-chloride prints dry a shade darker than they appear when wet.

274. It has been well remarked that the "shade of toning must be suited to the subject. To tone a sunshiny landscape to a cool grey, or a snow scene to a brown or any other colour but a cool grey, would be fatal."

275. **Management of toning baths.**—Much of the difficulty found in obtaining even tones in a batch of prints is due to unintelligent manipulation. If a bath sufficient for (say) twenty prints is measured out, and if the prints are toned in it in batches of five at a time, it is manifest that the first batch will be toned in a strong bath whilst each succeeding batch will be treated to a solution which is becoming progressively weaker and more exhausted. The first and perhaps the second batch of prints will be bright and vigorous, whilst the last will be mealy and poor.

The obvious remedy is to measure out enough bath for the whole number of prints, and to tone them *all at once.* Where the number of prints is too large to be manipulated at one time, both the toning bath and the prints should be divided into batches, each batch being toned *all together* in its proportion of *fresh* toning bath.

If the toning is too strong in gold, or is made too warm, its action is accelerated, but the prints lose greatly in the fixing bath. About two grains of gold should be allowed for each sheet (24½ × 17) of sensitive paper, and the same quantity for thirteen half-plate or thirty quarter-plate prints.

276. *Temperature of toning baths.*—In very cold weather, the washing water and the toning and fixing baths should be lukewarm (say between 60° and 70°).

277. *Keeping qualities of toning baths.*—Plain solutions of borax and sulphocyanide will keep indefinitely, but when the gold has been added, and they are set aside after toning, any gold which may remain in them is *rapidly deposited;* fresh gold must therefore be added when either bath is again required for use. It is manifest, however, that after an old bath has thus been repeatedly used the due proportion of its several ingredients is disturbed, because, whilst the gold is regularly renewed, the borax or sulphocyanide is steadily wasting. Many, therefore, prefer to throw away the bath after using it once or twice, and to make up a new one.

278. **Toning with gold.**—The formulæ for toning baths are endless, and are repeated over and over again in text books and photographic journals, so that it would be merely waste of space to reproduce many of them here. Suffice it to say that, for *ready-sensitised* paper, either albumenised or gelatino-chloride, there is perhaps nothing better than the borax bath,

which is as follows. The nitrate of uranium is considered to facilitate the obtaining of black tones—*it may be omitted if desired.*

No. 38. - Borax toning bath.

Borax	1½ drams.
Uranium nitrate ...	4 grains.
Water (boiling)	24 ounces.
Gold chloride (neutralised with chalk) ...	3 grains.

Should be made shortly before using the gold should be added to the dissolved borax, not *vice versâ.*

The borax should first be dissolved in the boiling water, and the other ingredients added after the solution has cooled. An ordinary white stoneware jampot is very convenient for making the borax solution; as it will stand the hottest water, it should be kept for this purpose only, and labelled with paint. Care should be taken not to allow the borax bath to get acid. When this is the case, correct it with a trace of carbonate of soda.

Neutralising the gold.—Before adding chloride of gold to any toning bath, the free acid of the chloride of gold should always be neutralised with a little chalk or dilute carbonate of soda.

279. Another favourite toning bath, especially for gelatino-chloride paper, is the sulpho-cyanide bath.

No. 39.—Sulpho-cyanide toning bath.

Ammonium sulpho-cyanide	36 grains.
Dissolved in water	24 ounces.
Gold chloride (neutralised with chalk)	3 grains.

Should be made shortly before using; the gold being added with constant stirring to the dissolved sulpho-cyanide, not *vice versâ.*

The Ilford formula for this bath is as follows: Ammonium sulpho-cyanide 20 grains, sulphite of soda 2 grains. Dissolve in twenty-five ounces of water, and add two grains of chloride of gold.

Paget's formula for the sulpho-cyanide bath is: Sulpho-cyanide 30 grains, water 16 ounces, gold 2 grains. It is an excellent toning bath.

The sulpho-cyanide has a softening action on the gelatine paper, and with some brands coated with *soft* emulsion it may be necessary to use a preliminary alum bath, but it is desirable to avoid this if possible, and to postpone the aluming till after fixing. The sulpho-cyanide bath tones quickly *on the surface,* but the toning must be continued till most of the red tint has disappeared, when the print is looked through by *transmitted* light. If the print is fixed whilst any portions remain distinctly red, such parts will tone to a *brown* colour.

280. **Combined toning and fixing bath.**—There is a very general feeling that pictures toned in "combined" baths are not permanent, and consequently it has been recommended that the prints after toning in the combined bath be afterwards treated with the ordinary hypo fixing bath. But as this is found to considerably weaken the pictures, Mr. Wilson prefers to fix the prints in a ten per cent. (two ounces to the pint) hypo bath *first,* and then to tone them in the combined bath. For this process, prints must be considerably overprinted to allow for the great reduction which takes place in the hypo bath.

No. 40.—Combined toning and fixing bath. (Eastman's.)

A.

Hypo ...	4 ounces.
Alum ...	3 „
Borax	1 ounce.

Dissolve the hypo and alum each in fifteen ounces of *hot* water, mix and then add the borax already dissolved in five ounces of hot water, finally make up with cold water to forty ounces—leave for a day to settle and decant.

B.

Gold chloride	15 grains.
Acetate of lead	64 „
Water distilled	8 ounces.

Dissolve the acetate of lead in the water and add the gold. A heavy precipitate forms, which should be shaken up when any is to be poured out. It redissolves when added to A solution.

For use.—Mix eight ounces of A with one ounce of B. Gelatino-chloride for prints toned in the combined bath need not be subsequently alumed.

281. **Toning with platinum.**—The platinum bath which appears to have met with the greatest favour for gelatino-chloride and albumenised prints is as follows:

No. 41.—Platinum toning bath. (Burton's.)

Potassium chloroplatinite	2 grains.
Citric acid	5 „
Common salt	8 „
Water	1 ounce.

Platinum baths for gelatine paper must be *acid.* The prints must be *well* washed in *soft* water before toning. When washing after toning, and before fixing, add a little carbonate of soda to the water to neutralise the acid. Fix in the *acid* hypo bath No. 16.

282. **Washing after toning.**—As each print is toned it should be submerged in a basin of clear water placed under the table or other place where the light is subdued. If the batch of prints is large, and the toning likely to last some time, it is well to throw an old focussing cloth or a newspaper over the basin to prevent discoloration of the prints. A pinch of salt in the water will prevent the toning action going on whilst the prints are soaking.

283. *Yellow stains* on gelatino-chloride prints are generally caused by contamination with hypo, the minutest trace of hypo either in the water used for washing before toning, or in the toning bath itself, or in the water in which the print is washed between toning and fixing, will cause these yellow stains.

284. **Pink tones in prints.**—This is one of the commonest faults in gelatino-chloride prints. It is chiefly shown in the half-tones, and sometimes appears as a distinct coloured line around the edges of a vignette. Mr. H. S. Fry, in an excellent article on the subject in the *British Journal of Photography*, 1893, attributes it to one of the following causes: (1) Insufficient gold; (2) too large a proportion of the toning adjunct, especially when this is sulpho-cyanide; (3) the use of a partially-exhausted bath.

A desirable precaution is to change rapidly the first of the washing waters before toning, and so get rid of the larger portion of the suspended silver.

285. **Prints by development.**—Prints on gelatino-chloride paper which have only received enough exposure to give a very faint image, quite useless for the ordinary toning bath, may be *developed* to full strength by suitable treatment. The following is the process recommended by the Paget Co.: The prints are exposed for one-tenth or one-twentieth of the

time which would be necessary for full printing out, and, when taken from the printing frames, are first placed, without washing, in a ten per cent. solution of potassium bromide, in which they must be allowed to remain until they are thoroughly bromised, the time varying from one to ten minutes, according to the age of the paper. Care must be taken to wet each print thoroughly before putting in the next to prevent their sticking to each other, and bubbles must be rubbed off with the finger. In this bath the prints require a yellow tone.

After removal from the bromide bath, the prints must be washed for at least three minutes in running water.

After this washing they are treated with the following developer:

No. 42. Developer for prints.

A

Quinol	¼ ounce.
Sodium sulphite	½ ,,
Sulphur*ous* acid	¼ ,,
Water to make ...	20 ounces.

First dissolve the sulphite, and then add the quinol. If hot water is used the solution must be allowed to cool before the sulphurous acid is added.

B.

Potassium bromide	1¼ ounces.
Liquor ammonia ·880 ...	1½ drams.
Soda carbonate recryst. ...	1 ounce.
Water distilled to make ...	20 ounces.

If distilled water is not available, and hard water must be used, a precipitate will be formed—the solution should be allowed to stand for a day and then be decanted.

For use.—Take one part of A, one part of B, and one part water. This will contain quinol four grains, bromide ten grains, liquor ammonia one and a half minims to each ounce.

The character of the developed print as regards gradation depends entirely on the number of grains of quinol per ounce of developer. About four grains (as above) will give a result similar to that produced by printing fully out by daylight; five grains give a softer print, and is better for a hard negative; on the other hand, diminishing the quinol increases contrast, and enables brilliant prints to be obtained from weak negatives.

As the developed picture is of a yellow tint (to be subsequently darkened in the toning bath), care should be taken not to over-develop it. When development has been carried far enough, it must be promptly stopped by *quickly* rinsing the print in water, and immersing it in a second bromide bath for a minute, and then *thoroughly* washing in water.

Then tone in the sulpho-cyanide toning bath (No. 39, para. 279), measuring out sufficient of the bath for the whole of the prints to be toned (about fourteen ounces of the bath per sheet, or half-ounce per quarter-plate print), and put the whole of the prints into it at once. For further details, consult the pamphlet by W. J. Wilson, issued by the Paget Co.

286. **Fixing.**—Never attempt to carry on toning and fixing operations at the same time, for failure is almost inevitable. If the slightest trace of hypo finds its way into the toning bath it will completely ruin it. Therefore complete the toning, put away all the dishes used for that purpose, and *then* proceed to fix.

Various strengths are recommended for the hypo bath, but our most scientific photographers insist that it must be sufficiently strong, because two hyposulphites of silver are formed during the process of fixing, one of which is most insoluble *in water*, but is readily dissolved by the excess of hypo in the bath.

A good plan is to have two hypo baths, one of a strength of one to seven, in which to keep the print for a quarter of an hour, and a stronger finishing bath of one to five, in which the print may remain another five minutes.

The usual formula is as follows:

No. 43. Fixing bath for prints

Hyposulphite of soda	3 ounces.
Ammonia	30 minims.
Water	21 ounces.

A fresh hypo bath should be invariably used for each batch of prints, and in cold weather it should be warmed to 70°. Mr. Wellington substitutes one and a half ounces of sodium sulphite for the ammonia in the above formula, and considers that the sulphite preserves the purity of the whites.

287. In fixing prints, there is, unfortunately, no such visible indication of the progress of the operation as there is when fixing negatives. It has, therefore, to be timed, at least fifteen minutes being generally allowed.

If a toned but unfixed print is held up to the light by the side of one that has been fixed, the whites of the fixed print will look clear and transparent in comparison with the whites of the unfixed print. Some persons can judge in this way whether a print is fully fixed, but the indications are too faint to be altogether relied on.

Keep the prints constantly moving, bringing the bottom ones to the top, and removing any air-bubbles that may appear. Use a large dish and plenty of the bath. Insufficient fixing is as often the cause of faded prints as stinted washing.

288. *Hypo eliminators.*—Numerous nostrums are sold under this name, but they generally do more harm than good. Permanganate of potash is the basis of some of them.

289. **Washing after fixing.**—Unless the *rationale* of this process is fully understood, the reasons for the recommendations here made will not be apparent. A fixed print is of the nature of a porous body, saturated with a highly deleterious chemical, which it is necessary to eliminate *completely*. Mere surface washing will *never* effect this, unless it is so prolonged that the substance of the paper is almost disintegrated; and it must not be forgotten that the secret of success in washing prints is, not only to wash thoroughly, but to wash *quickly*.

Of all mechanical aids for removing hypo from prints, a good *roller* squeegee is, in my experience, the best. But to be of any service the squeegee must not be one of those *hard* rubber affairs that are almost as useless and intractable as a roller of cast iron. What is required is a well-constructed article of comparatively large diameter made of the *softest* and *most elastic* rubber procurable. Such an instrument is invaluable.

Work with two dishes of water, and transfer the prints from one to the other at each change of water. While this transfer is being made, rest a plate of thick ground glass at a slight angle on the edge of the washing dish which holds the prints. Take these up one by one, lay them face downwards on the rough surface of the glass, and thoroughly roll them with the *soft* squeegee. The liquid pressed out falls back into the washing dish, and the squeegeed print is then transferred to fresh water in the second dish, and the squeegeeing process is repeated at the next change of water. Treated thus, prints are rapidly freed from all traces of hypo. For prints on albumenised paper either warm or cold water may be used, or warm and cold alternately, but for gelatino-chloride paper it is essential that the washing water be quite *cold*.

290. **Aluming prints.**—Albumenised prints do not need to be alumed, but the surface of the gelatino-chloride paper is so tender that it must be hardened. Therefore, after fixing, wash for not less than an hour, and then immerse the prints, face downwards, for ten minutes in a ten per cent. solution of common alum. This bath is necessary at all times, but is absolutely indispensable if the prints have to be subsequently squeegeed on to ferrotype plates or glass to get a high glaze. Then continue the washing with frequent changes of water until it ceases to show any milky appearance. An occasional squeegeeing between the changes of water greatly hastens the process.

For the so-called "opaline" prints, which are ordinary gelatino-chloride prints mounted in optical contact with glass, the aluming should be omitted.

291. When it is desired to give a glazed surface to prints on gelatino-chloride paper, they must be squeegeed down to some highly-polished surface. Compressed pulp slabs are excellent, and so are the ordinary metal ferrotype plates. If the prints have been well alumed, the pulp slabs or ferrotype plates may be used without any preparation; but it is a wise precaution to rub them over with a little of a solution of spermaceti one and a half drams, dissolved in benzole ten ounces, and to polish off with a dry, soft cloth.

The prints are then taken direct from the last washing water, and, without any draining, laid on the slab or plate, which is then rested in a sloping position for a short time to drain. If ferrotype plates are used, they may be taken in the two hands and slightly curved backward; this causes the surplus water to run off rapidly.

After draining the prints are covered with several sheets of clean blotting paper and a piece of American cloth (glazed side down), and the roller squeegee worked vigorously over the whole surface to expel the remaining water and air-bells.

The slabs or ferrotype plates are then hung up. No attempt must be made to remove the prints until they are quite dry; they will peel off spontaneously when ready. Glass plates or thick celluloid sheets *may* be used instead of the slabs, but they are not so satisfactory. They should be treated with the solution of spermaceti in benzole. Powdered mica (French chalk), so often recommended, is not nearly so efficient, and is far more troublesome to use.

If a mat surface is required on gelatino-chloride prints, they must be squeegeed on to *fine* ground glass, prepared with the spermaceti and benzole solution, or a mat-surface paper may be used.

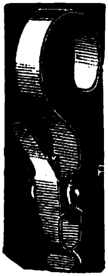

FIG. 12.

292. **Drying prints.**—The old-fashioned wooden clips are generally clumsy and badly made. A far better form of clip is that here illustrated. It is made of metal, and hooks on to a string stretched across the drying room; it can thus be readily detached, affixed to the print, and hung up again.

An additional use for these clips has been pointed out by Mr. Littledale. By fixing an ordinary bottle cork in the neck of the clip and suspending the print from the grip, the whole may be floated in a vessel of water, and the prints being thus kept hanging vertically and separate, the washing is greatly facilitated. For large prints this plan is very effective, two or more clips being used for each print.

293. *Reducing over-printed pictures.*—Farmer's reducer (No. 25) has been successfully used, being applied immediately the print is taken from the fixing bath, but in the hands of many it is found to communicate a yellow tinge to the whites of the print.

Mr. Lindsay used a hot saturated solution of alum, to each pint of which when cold two ounces of common salt and half an ounce of hydrochloric acid are added. The solution acts slowly but regularly, and when the print is of the right depth it is removed and washed thoroughly.

Or to a saturated solution of common salt add sufficient hypochlorite of potassium or sodium. The hypochlorite may be obtained in various forms, as eau de Javelle, ozone bleach, etc.

For *albumen* prints a weak solution of cyanide of potassium may be used —cyanide potassium 5 grains, ammonia 5 drops, water 1 ounce.

294. **Blisters.**—These annoyances are, fortunately, infrequent in gelatino-chloride papers; they are most likely to occur with what is called enamel or double albumenised paper. Much difference of opinion exists regarding the active cause of these troubles. The sudden transfer of prints between liquids of very different densities, such as from the fixing bath to the washing water, or from warm to very cold water, tends, amongst other things, to produce blisters. The remedy seems to be to avoid such sudden changes. For instance, after the prints are fully fixed, they may be allowed to remain in the hypo dish, and the bath gradually diluted with water, added at intervals, until it at last becomes so weak that the prints may be transferred to the washing water without danger of raising blisters.

Soaking in a solution of salt and water (one to fifty) between fixing and washing is sometimes effectual. Making all the washing waters and the toning and fixing bath lukewarm will occasionally answer.

Others recommend that the prints be transferred from the toning bath to water to which ammonia has been added in the proportion of one ounce to each gallon. Ammonia in the same proportion is also to be put into the fixing bath and the first washing water after fixing. Yet another remedy, which is said to be "infallible," is to immerse the prints, after toning, in a five per cent. solution of acetic acid. Many of the above recommendations are suited for *albumen* prints only.

The best remedy of all is a bath of methylated spirit (spirit 3 ounces, water 1 ounce). The prints are put into this *before fixing*, and left in it until quite transparent.

295. Transparencies may be made on albumenised paper by printing on the *back* of the paper until the picture is fully out when seen by transmitted light, and finally making the print transparent with a mixture of poppy oil 4 parts, Canada balsam 1 part, turpentine 2 parts.

Imitation photo-engravings may be made by interposing a "grained" film between the negative and the sensitive paper in the printing frame. The difficulty is to obtain a suitably grained film—see *British Journal of Photography*, 1893, pages 118, 165.

296. **Test for hypo.**—It is very desirable that from time to time the operator should test his prints. To do this it is not sufficient to test the last washing water, as whatever hypo may remain in the prints is probably imprisoned in the grain of the paper. A print or two should, therefore, be pounded up (with a little distilled water, if dry) in a perfectly clean mortar, then turned into a clean vessel with distilled water, well stirred up and allowed to settle. Captain Abney's test, which is as follows, should then be applied:

Test for hypo.

Potassium permanganate	2 grains.
Potassium carbonate	20 ,,
Distilled water	40 ounces.

A few drops of this rose-coloured solution will turn to greenish yellow or brown when added to water which is not free from hypo.

COLLODIO-CHLORIDE PAPER.

297. Collodio-chloride paper is treated much the same as gelatino-chloride paper. After printing, the prints must be *very thoroughly* and very *rapidly* washed in three or four changes of water.

Then immerse the prints in a five per cent. solution of common alum (one to twenty) for five minutes. Wash to remove the alum, tone in the sulpho-cyanide, borax, or any of the ordinary toning baths, fix in hypo, and wash thoroughly.

The only precaution I have found necessary is to be careful in flattening out prints with the paper-knife (para. 306). If this is roughly done, or if the paper is drawn at too sharp an angle, the collodion film is liable to crack.

SALTED PAPER.

298. In the first stages of the printing process, salted paper is treated very much like albumenised paper except that it must be printed very much deeper, as it loses greatly in toning and fixing.

Some recommend only a slight rinse in one water before toning, but others consider that much of the permanency of the print depends on a thorough washing at this stage—see para. 245.

The borax bath (No. 38) gives good dark tones, but it works better with salted paper when only of half the strength there prescribed.

As gelatine forms part of the formula for "salted" paper, all the solutions, including the washing water, must be *cold*. If warm water is used for washing, most of the colour gained in the toning bath is lost.

The fixing bath must not be stronger than one in ten, and the ammonia must be omitted.

PRINT-OUT PLATINOTYPE.

299. Instructions are sent with the "print-out" platinum paper. It must be printed to the full depth required, as there is no subsequent development.

"Print-out" paper has to be slightly steamed before use. This is done as follows: Fill a common pie-dish with *boiling* water, and cover it with a piece of canvas weighted down at the corners. Lay the paper on this for a *very short* time until it no longer crackles when bent. When enough paper for the day's work has been steamed, keep it in a light-tight box, and take out sheet by sheet as required.

Too much steaming tends to produce *brown*, rather than black, tones. The necessity for damping the paper before use causes a practical difficulty in the printing frame. When one half of the back is opened for examining the print, the moisture of that half of the paper rapidly evaporates, whilst that of the unopened half remains; the latter consequently prints darker than the former. This may be prevented in some measure by opening *both* halves of the printing frame alternately *each time* the print is examined, but, even with this precaution, a dark line is liable to occur in the centre of the print, unless the hinged backs are kept open for the shortest possible time.

Some operators with the print-out platinum paper consider that simply breathing on the paper is better than steaming it, but when this plan is adopted the paper should be taken out of the calcium tube some time before required for use, and allowed to absorb the ordinary moisture of the air of the dark room.

When there is a want of detail in the shadows of the print this may sometimes be brought out by breathing on the parts requiring to be strengthened as soon as the print is taken from the printing frame, and this is a valuable point in this paper, as with due care it is possible to strengthen any part of the picture.

Quick printing in bright light is needed for all platinum work. In poor light a general development is liable to take place all over the print, which, of course, clouds the picture.

Fair results are sometimes obtained from this paper, but the prints are seldom so vigorous as those from the ordinary hot or cold bath development papers. Dense negatives are most suitable, and as this paper is *very slow* it may be printed in direct sunlight.

FERRO-PRUSSIATE PRINTING.

300. Ferro-prussiate printing must be done in the brightest sunlight. Different brands of the paper assume different tints when fully printed, but with all of them a certain amount of bronzing in the shadows is necessary; no fixing is required with the ordinary blue paper, the prints only need washing, face downwards, in plain water. The first water should be rapidly changed, and all the washing done in very subdued light. Three changes of water are sufficient, as too much washing weakens the image.

PRINTING ON OPAL.

301. Opal plates are sent out in two kinds—in one the emulsion is on a smooth surface, in the other it is mat.

They need to be printed in a special frame, so contrived that the opal plate may be replaced on the negative in accurate register after examination while printing.

In all other respects, such as toning and fixing, the procedure is the same as for gelatino-chloride paper.

By masking the extreme edges of the negative a white margin is secured, which adds much to the effect of these pictures—see para. 266.

Instructions are usually sent out with the plates.

VIGNETTING, &c

302. **Vignetting.**—Various kinds of vignettes are used. There is the old glass vignetter flashed with red, the zinc vignetter, and the waxed paper vignetter, but the recently-introduced celluloid vignetters promise to supersede all the old patterns. The celluloid vignetter is the only one that will bear to be printed under in full sunlight.

Vignetters to suit special shapes may be readily made as follows: Take a piece of cardboard or thin sheet lead, cut in it a hole smaller than the required vignette, snip the edge all round with the scissors and turn it up. Lay it on the front of the printing frame and fix in position with a few pins driven through the cardboard or lead. A piece of thin tissue paper laid over the opening in the vignetter greatly softens the picture. The printing frame should be laid flat on its back in subdued light, and its position frequently changed to secure evenness.

The softness of the vignette is greatly increased if the printing frame can be kept in constant horizontal motion. As roasting jacks, though excellent for the purpose, are things of the past, the best substitute is to hang a small square board from the ceiling by string from the four corners. When about to print, the board is turned a number of times till the suspending strings are well twisted; being then released it will revolve steadily, and with an occasional twist will continue in motion till printing is completed.

303. **Vignetting in the camera.**—Black vignettes may be made *in the camera* by inserting a blackened card, with a suitable vignetting aperture, between two folds about the middle of the bellows. The print from an

ordinary negative may be black vignetted by protecting the central portion with a suitable mask, and allowing the outer margins to darken. White vignettes are done by supporting a white cardboard vignetter on a suitable stand between the object and the camera, but if much light is reflected from them it is liable to fog the negative.

304. **Masks and discs.**—By these, various effects may be produced. If the picture, after printing, is shaded with a disc, and exposed to the light, a dark margin is the result, and the process is much simplified if the *disc* is mounted on a piece of glass somewhat larger than the print; the two are then much more easily adjusted. If the margin is shaded with a mask, a dark picture on a light ground is produced. Discs should always be a trifle smaller than the corresponding opening in the mask, or white lines often result from the difficulty of accurate registration.

Celluloid negatives are now sold for printing ornamental borders round ordinary pictures; some have been submitted to me which are quite pictures in themselves.

305. In negatives of interiors, portions are apt to be densely insensitive. The printing of these portions may be aided by directing a circle of *diffused* light on them with a magnifying glass, but care must be taken to avoid bringing the light to a focus, and to keep the circle of light in motion to prevent hard lines.

CHAPTER XIII.—MOUNTING AND FRAMING.

The effectiveness of a photographic print depends more upon the suitability of the mount and frame than is generally supposed.

306. **Flattening prints.**—The first thing to be done is to remove the curl which most prints acquire during drying. This is readily effected as follows: Lay the print face downwards on a blotting-pad, and place on it the edge of an ivory paper-knife, then hold one margin of the print in the left hand and draw it steadily from under the paper-knife, using sufficient pressure. Repeat in various directions till the print lies fairly flat.

307. **Trimming prints.**—When working with small sizes there is a natural disinclination still further to reduce the already small picture, but in many cases this must be ruthlessly done if the best effect is to be produced. A long, narrow subject, in which both sky and uninteresting foreground bear undue proportion to the rest of the picture, is greatly improved by liberal curtailment at top and bottom. A comparison of a trimmed and untrimmed print of such a subject will prove, beyond doubt, that the reduction has greatly improved the whole as a "picture."

No rules can be given for trimming prints; the amount to be removed must be left to individual taste, but it should be remembered that "to spare the print is often to spoil the picture."

308. A good number of cutting shapes, gradually decreasing in size, should be kept on hand, so that one best suited to the print may be selected. These shapes can be purchased, or may be readily made by anyone able to use a cutting diamond. The sharp edges should be taken off with the emery rubber alluded to in para. 200.

309. A stout sheet of zinc is the material best suited for cutting on. It should be mounted on a suitable board, and if made to turn on its centre it will be found very convenient in use. Any knife will do, provided it is of good steel and is kept sharp by constant whetting on a fine emery rubber. For cutting ovals or shapes not composed of straight lines, the swivel pattern wheel cutters are essential.

310. **Paste mountants.**—A good paste should be strongly adhesive, and should not cockle the mounts or pages on which the prints are fixed. Many simple pastes possess the first quality, but are lacking in the second. A stiff paste made of good Bermuda arrowroot is very adhesive, is quickly made, and is excellent for mounting prints on cards which have afterwards to be rolled or burnished, but when used for inserting prints in albums it is difficult to prevent some amount of cockling. Where, however, prints are mounted on both sides of the leaf the cockling is greatly neutralised. Neither flour paste nor gum should be used, as they both tend to injure the prints.

Pastes of all kinds rapidly become sour, and should not then be used on any account. If a few drops of carbolic acid or oil of cloves, or a few grains of quinine, are well stirred into the paste when taken off the fire, it will keep in condition longer than if made without these additions.

311. *To prevent cockling.*—Even when using ordinary paste mountants, the amount of cockling may be materially reduced by first pasting the prints and then laying them on a frame of open canvas to dry. When quite dry, *quickly* paste them again, lay then at once on the mounts, rub down rapidly, and set up to dry. If a piece of thick filtering paper, cut a trifle larger than the prints to be mounted, is damped and allowed to lie on the mount for a short time so as to slightly moisten it, the tendency to cockle will be much lessened. A clean pocket-handkerchief folded to the required size and damped is equally good, and does not tear like the filtering paper. If mounts are greasy, sponge them with a ten per cent. solution of washing soda.

312. *Specially-strong paste.*—This is composed of arrowroot (or starch) and gelatine, and if properly made, with only the right proportion of water, it does not cockle even thin mounts. Take one dram of Nelson's gelatine and let it soak in cold water for at least an hour. Then take the inner vessel of a large glue-pot, put into it one ounce of the best Bermuda arrowroot, with one ounce of *warm* (not hot) water, mix well, and then pour in gradually five ounces of boiling water from a kettle, stirring the mixture vigorously the whole time; it will be found to form a thick jelly.

Now replace the inner vessel into the outer part of the glue-pot, place it over a gentle fire, and when thoroughly warm put into it the gelatine (from which the water has been previously strained off), and continue stirring until it is thoroughly incorporated with the paste. Let the whole simmer very gently for, say, a quarter of an hour, take off the fire, and add five grains of thymol or ten drops of carbolic acid, or two grains of quinine with one ounce of methylated spirit and ten drops of ammonia, stir again, and pour into a covered gallipot, leaving off the cover until the mixture is cold. This paste will keep for a long time if carefully covered.

313. **Gelatine mountants.**—A thin solution of gelatine, kept warm in a glue-pot, is commonly used by those who have large numbers of prints to mount. It has the advantage of not cockling the print to any great extent, but it requires considerable skill on the part of the operator, as the print, once laid on the mount, cannot be moved about to rectify its position as easily as can be done when pastes are used.

Ready-made gelatine mountants are sold by photographic dealers—they have all the advantages and disadvantages of the home-made solution, and, like it, must be warmed before use. They are all liable to become far too thick, and should then be warmed and diluted with methylated spirits thoroughly mixed in.

314. **Mounting gelatino-chloride prints.**—These should be allowed to become quite dry. They may then be mounted with very stiff cold paste in the manner described in para. 311. The specially strong paste (para. 312) is even better, as it contains less water than ordinary paste.

Mr. Woodbury, in an excellent article in the *Camera*, points out that as gelatine is particularly susceptible to moisture, a mountant containing much water will completely remove the gloss from gelatino-chloride prints. He therefore recommends the use of the following: Soak one ounce of gelatine in cold water; when soft, squeeze out as much water as possible, dissolve with heat, and add four ounces methylated spirit. This is rapidly brushed over the back of the print, and the latter immediately applied to the mount, smoothed down with a soft clean rag, and the whole laid away face upwards to dry. Mounted prints must not be laid on one another, or they will stick.

If it is desired to retain the utmost gloss on the prints, they must be treated with a protective backing, made of some kind of waterproof paper, procurable from most photographic dealers. Pieces of this, cut to one-eighth of an inch smaller each way than the prints, are coated with the mounting solution on the white side, and then applied to the prints *while still on the glass.* When dry, the prints with their backings will strip, and can be mounted with almost any adhesive, as the waterproof coating prevents the damp from affecting the gloss.

315. Mr. McDougall takes celluloid films from which the emulsion has been removed, cleans and polishes them with Castile soap dissolved in alcohol (see para. 403), and cuts them to the exact size which the prints are to be when finished. He squeegees the gelatino-chloride prints on to the smooth or mat side of the films according to the surface required, trims the prints to the size of the films, and when the squeegeed prints have partly dried upon the celluloid sheets, he pastes them and affixes them to the mounts, rubbing them down with a roller squeegee. They are then placed under pressure, and when *thoroughly* dry the celluloid will strip off, leaving the print firmly attached to the mount.—*Wilson's Magazine.*

MOUNTS.

316. There are two distinct styles of mounting prints. In the one the print is simply attached to a plain or plate-sunk mount; in the other it is placed behind a "cut-out" mount. Each style has its advocates, and a good print looks well either way, though when not required for framing the first style is the simplest and best.

317. **Suitable tints for mounts.**—A visit to any exhibition of photographs will show how varied are the opinions regarding the best mounts for prints.

For platinotypes and bromides.—The object of many now seems to be to make their pictures look as much as possible like copper-plate engravings. With this view, they are mounted on white plate-sunk mounts, with narrow India tint around the picture. If the white of the mount is either very coarsely grained* or *very slightly* tinted, so as to do away with the glaring chalkiness of ordinary white paper, and if the inner India tint is of the proper shade, viz., a very light grey with a slight olive tinge, the effect is good, but a chalk-white mount with an inner tint of any shade of yellow or buff is far from pleasing.

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* A very effective cross grain may be made by first damping the upper surface of an ordinary mount, and then leaving it until it has become surface dry. A sheet of fine tissue paper is first laid on the mount and then a sheet of coarse glass paper. The whole is then put into a strong screw press and left for an hour or two. A print immediately after mounting, may be treated in the same way.

Very rough-surfaced white drawing papers make good mounts, and so also do the tinted papers of the same quality.

In my own practice, I have tried every sort of mount and every variety of tint, and though I have by no means arrived at any hard and fast conclusion, I incline to think that (when it is not desired to imitate an engraving) *platinum and bromide prints* look best on a plain French-grey mount of *very light* tint, and this seems to comply with the rule which prescribes "that the tone of the mount should not be lighter than the lightest part of the print," whilst, at the same time, "strong contrasts between the colour of the mount and of the print should be avoided." With this grey mount, no India tint is necessary or desirable.

Many photographers use tinted mounts, and print their pictures with a white margin of varying width, and some even add an outer India tint to this. Needless to say, the effect is not good, and this "rainbow" setting is only mentioned to be deprecated.

For silver prints, a perfectly plain mount of *very light* buff or cream colour (not yellow) has been found suitable.

The best mount *for mat prints* depends chiefly on the colour to which the pictures are toned. When this approaches black, the recommendation for platinum prints applies, but for warmer colours the light buff mount is preferable.

318. **Plate-sunk mounts.**—A plate-mark on a mount of uniform colour sometimes improves it, though the advantage is so trifling that it is frequently more than counterbalanced by the drawback that, as plate-sunk photographic mounts are pressed in certain fixed sizes, any print which needs exceptional trimming will probably be out of proportion to the space left within the plate-mark.

Plate-sunk mounts may be home-made by placing a thick mount with rounded corners, the size of the plate-mark required, on the mount to be operated on, and putting the two under a strong press. This is best done when the print is nearly dry.

319. **Size of mounts.**—The amount of margin to be left round a print intended to be framed, in other words, the best size of mount, has to be considered. A small print in the middle of a sea of mount looks poor, except in very special cases. The same print with insufficient margin is insignificant. Perhaps a 12 × 9 or 10 mount is best suited for half-plate pictures, and a 6½ × 5 for quarter-plate prints. The former is large enough to be framed, and not too large for the size of the picture. Slightly more margin should be left at the sides than at the top and bottom of a horizontal picture.

320. *Cut-out mounts.*—The above recommendations as to colours apply equally to cut-out mounts. Prints under cut-out mounts should not have any visible white margin.

FRAMES.

321. I have also experimented with frames of all sorts. The following kinds are neat and inexpensive, which is a consideration where numbers are required.

For *silver prints*, plain frames of three-quarter inch unpolished oak, or plain gold flats of the same breadth, are perhaps the simplest and best.

For *platinotypes and bromides*, all of the following have proved effective, the breadths given being for half-plate prints on 12 × 10 mounts:

Half-inch plain gold "flat."

Seven-eighth inch "Birket Foster" moulding.

Three-quarter inch "flat" of unpolished oak with an inner "flat" of half-inch gold (of which only a quarter of an inch shows).

Carbon prints, when of the ordinary brown shades, look well in plain walnut-coloured frames, with a narrow gold "flat," and may, if preferred, be mounted without any visible margin.

322. We are told by many that it is not desirable to arrange several photographs in one frame, and certainly, to see several landscapes placed one above the other, so that a church steeple may perhaps be arranged under a stormy sea view, is not suitable. There can, however, be no possible objection to framing two or more pictures *in the same plane*, especially if these are put behind cut-out mounts. In large rooms, or at photographic exhibitions, it is difficult to make very small pictures effective in any other way.

In a panoramic view taken on several negatives, it is almost impossible to print the several portions so equally that the joints will not be apparent. A long cut-out mount, with *very narrow* divisions between the several portions of the picture, is perhaps the best way of framing these unmanageable subjects.

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323. **Burnishing.**—The difference between rolling and burnishing is not always fully understood. When prints are *rolled*, they are passed through a press, which consists either of two rollers or one roller and a flat plate; the polish, therefore, results from the great *pressure*, which condenses the paper of the print. Rolling presses are not, as a rule, heated. On the other hand, burnishers are invariably heated, and the prints are *drawn* over a fixed bar; the polish is therefore the result of *friction*, and to prevent injury to the prints they are first rubbed over with a one per cent. solution of Castile soap in methylated spirit. The polish obtained by burnishing is better than that from rolling.

324. *To enamel prints.*—Dissolve four drams of gelatine in ten ounces of water, and whilst warm immerse the prints in the solution. Meanwhile, take a glass plate which has been thoroughly cleaned with French chalk, and coat it with enamel collodion, wash until the greasy lines have gone, and then place a print face downwards on the glass, put a piece of india-rubber cloth over it, squeegee into close contact, and stand up to dry. When *quite* dry it may be readily stripped from the glass. If the prints have been cut to size before soaking in the gelatine, the mounts may be fixed to them whilst still on the glass plate.

Anthony's Bulletin says that if a glass plate is coated with a mixture of oxgall and alcohol in equal parts, and an albumen print is then squeegeed down on it, it will, when dry, strip with a fine glazed surface.

But it is sometimes required to get a mat surface on a glazed print. The *Kodak News* gives the following process: "Lay the print face up on a clean sheet of paper, and dust on it finely powdered pumicestone, and rub it evenly over the surface of the print with the finger for about a minute."

325. **Mounting prints on glass.**—Prints for mounting in optical contact with glass "should always be masked so as to leave a white margin all round the edge of the glass, the result being that great brilliancy and delicacy is imparted to the photograph." The following method is recommended: After the prints have been toned, fixed, and washed, blot off and dry between blotting boards under pressure. Soak about two ounces of sheet gelatine in cold water until soft, then add about ten ounces boiling water. When the gelatine is *thoroughly* dissolved, filter it through muslin into a clean glass or porcelain dish standing *in a hot water bath so that the temperature may be kept at about* 100° *Fahr.* See that your glass or glasses are *thoroughly clean,* and then, standing in front of the dish of gelatine, place the dry prints in a pile face downwards on the right-hand side, and the glasses in another pile, and also face downwards, on the left, immerse a print in the gelatine with the right hand, and take a glass in the left. As soon as the print is soaked lift it out of the gelatine, *lay it quickly on the glass, and at once firmly squeegee it.* When the gelatine is perfectly dry, the print can be easily trimmed to the exact size of the glass on which it is mounted. For opalines the struts should be attached to the back of the print with thin hot glue.

"If the italicised portions of the foregoing instructions are carefully attended to, there will be no difficulty in obtaining the best results."

Glass plates of suitable sizes with bevelled edges may be obtained from photographic dealers.

326. **Photographic albums.**—To make photographic albums look effective, the following rules should be observed:

Glazed and mat surface silver prints should not be mounted indiscriminately in the same book with platinotype and bromide prints; the styles are so different that they depreciate each other.

Books of upright shape should be used for upright pictures, and oblong books for those taken the lengthway of the plate. Few things are more annoying than to have to twist a book about when looking through it. For those who print in several styles, many albums will thus be needed, but the satisfactory result is well worth the slight additional expense.

The size of album best suited for half-plate pictures is that called "demy quarto," measuring 9½in. × 7in., and bound either in "upright" or "oblong" shapes. Albums of this size, each containing thirty leaves of stout card, may be had in white for about three shillings each, and with tinted cards for a little more. The same sized album or one slightly larger will take four quarter-plate pictures on each page.

The recommendations as to the best colours for mounts (para. 317) apply also to albums. The titles may be written on the backs of these books with a fine brush and a little vermilion oil colour. Books of the size recommended will be found to fit comfortably into any bookcase.

When mounting pictures in books, a piece of dry blotting-paper should be placed between each pair of prints before turning over the leaf to go on with the next; this prevents their sticking to each other.

CHAPTER XIV.

PHOTOGRAPHY IN HOT CLIMATES.

327. "India is so vast a country that what may be considered very suitable for one part is quite unsuitable for another; it is all over alike in one particular, and that is, that during some portion of the year (greater or less according to the latitude) it is always intensely hot. On the western coast it is always more or less damp, and during the S.W. monsoon (May to August) the atmosphere is simply saturated with moisture, while in the Deccan, Central India, Rajputana, and the Punjab, the dryness, during the greater part of the gear, is so intense that none but the most perfectly-seasoned woodwork has a chance of survival.

328. **Apparatus.**—"Cameras and dark slides for any part of the country should be of perfectly seasoned wood, and all joints should be *screwed* together—glue, by itself, is of no use in the damp atmosphere of the West Coast. Brass binding to everything is an additional comfort, but is not absolutely essential if the wood be perfectly seasoned. Square cameras with reversing backs are most useful, as so many vertical subjects present themselves in the shape of tall buildings and magnificent trees.

"Lightness is a matter of no importance whatever; solidity and rigidity are the main points. No European ever thinks of carrying anything beyond, perhaps, an umbrella, and as coolies convey all the apparatus, weight (within reasonable limits) is not a consideration. A coolie can carry, without distress, a camera 12in. × 10in., six double dark slides, with one dozen plates, tripod legs, and head, and a lens case; his pay may vary from four to six annas (say 6d. to 9d.) a day of eight hours.

"With a 12in. × 10in. apparatus it is best to pack the camera and focussing cloth in one case, with two extra cases each to contain three of the dark slides. The camera screw should be fastened to the tripod-head, and the triangle should be strapped to the legs. The whole kit weighs about 45 lbs.

329. **Plates.**—"No trouble is usually found now with any of the leading makers' plates in the way of frilling and melting, even in the hottest weather, and I have developed plates when the water was quite warm and the temperature of my dark-room well over 100°.* The more sensitive a plate is the more difficult it is to keep in good order.

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* Good negatives seem to be obtainable on most of the principal makers' plates so long as they are procured fresh, but after an experience of many years I am bound to state that, in my opinion, there is no plate to compare with Wratten and Wainwright's Instantaneous and Ordinary plates for tropical climates. I have now (1891) some Wratten's Ordinary which came out in the autumn of 1887; they have been kept on a shelf in a cupboard with no particular care, have been through four monsoons and four hot seasons, and are still as perfect as the day they were made. Thomas's lantern plates keep perfectly, which is more than can be said for a number of others.

Lantern plates.—"Chloride plates are practically useless, unless obtained fresh direct from the makers and used up without delay.

330. **Exposures.**—"There is practically no difference between the exposures in India and those in England on a bright summer's day. If anything, a little longer exposure is advisable in India, to counteract the excessive contrast between the lights and shadows, especially in cases of white buildings against masses of dark foliage.

330A. **The development of negatives in the hottest climates.**—M. Mussat has continued his experiments as to the hardening of the film of the negative plate by means of formalin. A plate immersed, after exposure, in a four per cent. solution for two or three minutes, gives, on development, an irreproachable image, photographically speaking, although the development is a little slower than under ordinary circumstances; but this disadvantage is well compensated for by the fact that one may develop without fear at the highest temperatures of the tropics. An explorer need only take a small quantity of the commercial forty per cent. solution, which can be diluted as required, in order to be free from all risk on the score of temperature. M. Mussat is at present not able to speak confidently as to whether it would be safe in all cases to treat plates with the formalin bath in advance, but he soaked some of Lumière's blue label plates for two minutes in the above formalin bath, and when these were exposed and developed two months afterwards, no deterioration of any kind was noticed.—*Photographic News.*

331. **Lenses.**—"One cannot have a better assortment for a 12in. × 10in. camera in India than a rapid symmetrical lens of 18in. focus for general subjects, and a portable symmetrical of 9in. or 10in. focus for interiors. The back combination of the rapid symmetrical makes a very fine landscape lens for pictures of distant mountains, etc.

332. **Ordinary sensitised papers.**—"It is very seldom that one can depend upon getting a supply of ordinary silvered paper in really good condition, and the greater portion of the sensitised paper which comes to India arrives more or less discoloured and stained. Sensitised paper will keep for many months if only one point is carefully attended to, and if manufacturers would only see that the freshly-sensitised paper was made *perfectly dry*, and soldered up *at once* in good tins, their trade would soon increase.

"I have received supplies properly packed, and on receipt have at once cut up the whole lot into pieces for my 12in × 10in. negatives, and stowed it away in an ordinay platinotype calcium tube; the paper has kept good for months, and the last piece was as good as the first. At other times I have received supplies of three or four quires at a time in soldered tins, every heet of paper being quite brown, and covered with streaks and stains; the apers have not been a cheap kind, but from makers with a reputation.

333. **Gelatino-chloride paper.**—"Nothing equals this for keeping ualities. I have had some in a calcium tube for nearly three years, and it almost as white as the day it arrived, but, unfortunately, it is practically nworkable at any time of the year in a climate like Madras. I have used ome in December and January, and got satisfactory results by first icing

the prints, and using iced water for all the solutions and washing waters. On the hills, and in the cold weather in the North of India, it, of course, can be worked, and very beautiful results can be got from negatives slightly too thin for ordinary silver printing.*

334. **Collodio-chloride paper.**—Owing to the insoluble nature of the emulsion, this paper seems likely to be very valuable for use in hot and damp climates.—*H. P. H.*

335. **Bromide paper.**—"This requires more care than plates, for, in consequence I suppose of the paper covers, it is much more susceptible to damp. It is not possible to work with it satisfactorily in the hottest weather, but from November to February inclusive good results are very easily obtainable.

336. **Platinotype.**—"This can very easily be worked in some parts of India, such as the Deccan, Rajputana, etc., where the atmosphere is intensely dry, but in damp places it is most difficult.

337. **Plain paper.**—"This process, so ably described by Mr. Lyonel Clark, is to my mind the most satisfactory of all printing methods for India. The coating of the paper is very easy, and the results most artistic. Prints by this process on cartridge paper, printed deeply and fixed without toning, are of a most beautiful reddish-brown colour, most suitable for the many architectural subjects in red sandstone. Toned with platinum, plain paper is suitable for subjects in granite."—*F. Dunsterville.*

338. **Metal dark slides.**—For use under the exceptionally trying conditions of tropical climates the metal slides made by Mr. Tylar, of Birmingham, are invaluable. They are quite unaffected by changes of temperature, and will remain light-tight long after wooden slides have become unserviceable.

As very few metal dark slides have the hinged dividing plates which form part of the ordinary wooden back, they are fitted in a different way. In Tylar's pattern *both* plates are put into the side of the slide which carries the double ridge; the other half of the slide is then turned over, and the whole closes easily. Metal slides are so numbered that when the *odd* number is at the top the slide can be opened, a plate taken out, and the slide shut again with ease; but if the *even* numbers are turned uppermost, the plates are liable to shift and prevent the slide from closing. The division cards for placing between the plates need not necessarily be black; brown or yellow cards are equally effective.

A metal slide to hold single plates has been specially contrived by Mr. Tylar for use with hand cameras. In this the plate is placed film upwards, and held in position by a hinged flap—the slide shutter is so constructed that it cannot scratch the film.

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* In hot climates the alum bath must be used *before toning*.

CHAPTER XV.

Enlarging and Lantern Slides.

339. There can be no doubt that *size* is an important factor in a photographic picture. But of late years there has been a steadily-increasing tendency towards the use of small plates, partly because of the easier portability of the apparatus required, and the greater economy of small sizes, but mainly because the hand cameras now so largely used are seldom made to take larger pictures than quarter-plate or 5 × 4. The probability is that of every one hundred plates exposed, at least eighty are of these small sizes; any arrangement, therefore, by which the amateur can enlarge and make more presentable pictures from the best of his negatives is of considerable value to him.

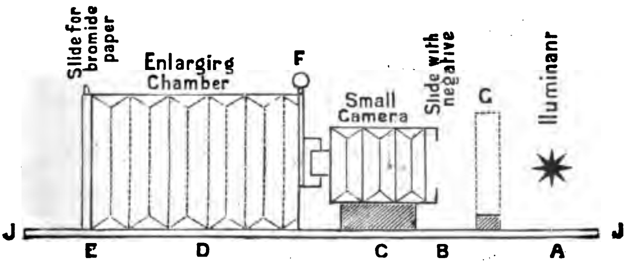
But so few enlarge from their own small negatives that it is often considered to be a difficult process, and once more suited for a large professional establishment. This is far from being the case, as will be shown in this chapter. Many of the explanations here following will be superfluous to those who have done similar work, but the details of the process have been purposely amplified for the benefit of those who are about to take it up for the first time.

340. **Negatives for enlarging.**—It must always be remembered that a negative from which an excellent contact print may be obtained is not necessarily suitable for enlarging. A comparatively soft negative with abundant detail and gradation and without harsh contrasts is desirable, but it is absolutely essential that it should be *sharp* and well focussed.

A negative can readily be tested for sharpness by looking at it from the glass side, through a good focussing glass.

341. **Enlarging apparatus.**—Various forms of enlarging apparatus are extensively advertised, and the amateur will find but little difficulty in selecting the pattern best suited to his requirements and his pocket.

The diagram (fig. 13) here given must not be supposed to represent any



Apparatus arranged for ENLARGING.

FIG. 13.

special arrangement for enlarging, or one that is recommended as preferable to many others which are in general use; it is rather intended as an *ideal* sketch of the several parts which go to make up *all* the various patterns of enlarging apparatus.

"A" is the "illuminant," which may be daylight—or lamplight—or limelight or burning magnesium ribbon.

"B" is a special slide to hold the negative from which the enlargement is to be made. It is so constructed that the negative, when placed in it, can be moved both horizontally and vertically, so that the best parts of the plate may be included in the finished work.

"C" is an ordinary camera with lens. The camera is raised by any suitable means, so that its axis may be in the same line with that of the larger camera or chamber.

"D" is a chamber, the dimensions of which are somewhat more than the greatest enlargement that is required to be made. This chamber may be of ordinary deal wood, but a simple bellows enlarging camera (as shown by the dotted lines) is more convenient. The chamber may even be dispensed with altogether, and an upright frame or easel set up at "E" to receive the sensitive bromide paper, but this arrangement requires that the whole room be darkened.

"E" is the position of the bromide paper on which the enlargement is to be made. The best arrangement is a large dark-slide fitting into the end of the large camera or chamber, because the picture can then be carried off to a dark room for development. The slide should be provided with a movable ground glass for focussing.

"F" is a sliding trap-door, which is raised when the exposure has to be made.

"G" shows in dotted lines the position of the condenser *when such is needed.*

"J J" is a stout frame, to which all parts of the apparatus can be clamped, and on which they can be made to slide to and fro.

ENLARGING WITHOUT A CONDENSER.

When a condenser is used for enlarging, it must be the full size of the negatives to be enlarged from, and as such an item is somewhat expensive, those methods by which enlargements may be made without its use will be first described.

342. **Enlarging by daylight.**—For this process a condenser is not necessary. The negative to be enlarged from is inserted at B (fig. 13), film side facing the lens, and is carefully focussed on the ground glass of the dark slide at E, both cameras being, if necessary, moved to and fro until an image of the required size is obtained. The slide E is now taken to the dark room, the ground glass removed, the bromide paper inserted, and the slide replaced in the large camera. The end of the apparatus which holds the negative B is now placed at an open window or out of doors, and pointed to the sky, the negative end being elevated as much as may be needed to give a clear horizon free from chimneys, trees, etc.—see fig. 14. If a clear horizon cannot be thus obtained, a large sheet of white card-board, or opal glass R, must be fixed at an angle of 45° to reflect the light from the sky above into the negative. The exposure is then made.*

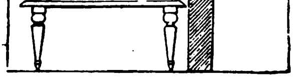


FIG. 14.

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* The plan of darkening the whole room by blocking up the windows all but enough to illuminate the negative, and receiving the enlarged image on the bromide paper fixed to an open easel, is so very inconvenient in the majority of cases that it is not here described.

343. **Enlarging by lamplight.**—Again referring to fig. 13, the same parts of the apparatus are required, omitting the condenser and adding the illuminating lamps at A. But if, as is not infrequently recommended, these lamps are placed *directly behind the apparatus*, that is, on the spot marked by the * in fig. 13, so that their light shines straight on to the negative, the images of their flames will be transmitted more or less distinctly, and will be visible on the enlargement, and if, to prevent this, a diffuser either of ground or opal glass or mineral paper is interposed, so much of the light is stopped that the exposure becomes inconveniently long. If, however, instead of placing the lamps in front of the negative, they are removed to *each side of it*, as shown in *plan* at fig. 15, and so placed that none of the rays can shine direct into the negative, and if a white cardboard or opal reflector is fixed at R, no diffuser is necessary, and a clear even light is transmitted through the negative.

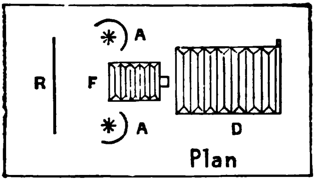

Fig. 15.

Any powerful paraffin lamps can be used. An excellent pattern is the lamp "Belge," with circular wick. The ordinary globes are removed, and parabolic reflectors are fitted round the clear glass chimneys. These reflectors cost about 7s. each.

344. **Enlarging with magnesium ribbon.** Here again the portions of apparatus in fig. 13, marked B C D E F, are required, with the addition of a diffuser, and the lighted magnesium at A. When the negative to be enlarged from does not exceed quarter-plate, a sufficient length of magnesium wire may be grasped with a pair of pliers, and after being lighted should be moved about rapidly behind the diffuser, so as to illuminate every part of the negative, especially the corners. The diffuser may be of ground glass or mineral paper, and if the latter is used it is well to gum it by the four corners to a sheet of glass, and fix it vertically, paper-side towards the negative, so as to avoid the risk of setting fire to it when burning the magnesium.

For *large* negatives a sufficient number of pieces of magnesium ribbon are suspended from a wire frame behind the diffuser, and ignited, it not being apparently of much consequence if they do not all light quite simultaneously. As much as sixty inches of ribbon may be required for a large negative, much, however, depending on its density and on the nature of the diffuser, and its distance from the negative.*

In all cases the diffuser should be as close as possible to the negative, and e wire not more than about three inches from the diffuser, if it can be nited so near without risk to either diffuser or negative, and a large sheet f bright tin placed behind the burning magnesium helps brilliancy.

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* A plan has been proposed for illuminating the negative by means of a mixture of agnesium powder and chlorate of potash, affixed in dots over a sheet of paper, and then nited. But the amateur is recommended to have nothing to do with any explosive compound.

These plans give good results with some, but they have the very great objection of generating so much acrid vapour that the room in which the operation is carried on rapidly becomes unbearable. Endeavours have been made to obviate this by enclosing the magnesium ribbon in a box, with a tube communicating with the open air to carry out the smoke. This is obviously inconvenient in cold weather, and, in fact, it generally ends in the cold air rushing in instead of the magnesium vapour going out.

Many other plans of enlarging without a condenser have been tried and ventilated in the photographic prints, but I know of none that have been *proved* to be *practically* efficient.

ENLARGING WITH A CONDENSER.

345. Though the *patterns* for enlarging apparatus vary greatly, the *principle* is exactly that depicted in fig. 13. For enlarging *with a condenser* the whole apparatus there shown is needed. In the commercial apparatus a powerful lamp or limelight represents the illuminant A, the negative is inserted in a groove in the body of the enlarging lantern corresponding with B, and the front bellows and lens answer to C. Here, however, the enlarging apparatus as sold, usually stops, leaving the purchaser to provide the large camera D and the holder for the bromide paper E.

346. **Enlarging with a lamp and condenser.**—But to prove that very expensive apparatus is not absolutely essential, fig. 16 shows a comparatively simple arrangement which has been found to answer exceedingly well. Here the source of light is an ordinary round-wick paraffin lamp removed from its pedestal, deprived of its globe, and fitted with the parabolic reflector alluded to above. It has one great advantage over the three or four-wick lamps of the ordinary bought apparatus, viz., that the light can be turned up or down and regulated with accuracy, and as the consumption of oil is comparatively small, it may be left burning at full power the whole evening, whereas the larger lamps of the special enlarging apparatus will not burn nearly as long, and if turned down between the several enlargements it is often a tedious business to get an even light when again required.

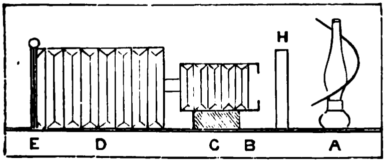


FIG 16.

It has the advantage over limelight that it is always ready for use, the nearest table lamp being appropriated, though it is better to keep one for this special purpose only. The light not being so powerful as that used in most enlarging cameras, a somewhat longer exposure will be found necessary.

347. **Enlarging with an ordinary optical lantern.**—Portions of a quarter-plate negative (such portions being limited to about three and a half square inches) may be enlarged in a good optical lantern, the negative being placed in the slot made for the lantern slide, a rapid rectilinear or portrait lens being used instead of the ordinary optical lantern lens.

But an optical lantern cannot be used to convey light to a negative outside itself, that is, it cannot be used as the illuminant at A in fig. 13, because, when the rays emerge from the lantern lens, they commence to diverge at once, so that a negative placed in front of such a lantern only receives light from the small bundle of rays which pass through the *centre* of the lens. An optical lantern, however powerful, when thus used is not nearly so efficient as the arrangement with an ordinary lamp described above.

348. *Visible enlarging.*—The impression made by light on ordinary bromide paper is not perceivable by the eye, and, as is well known, the picture has to be subsequently developed like a glass negative. Nevertheless, the actual printing of a photographic enlargement, whilst still on the easel, is possible. The effect is attained by treating the moistened bromide paper with a suitable sensitiser; the light, acting through the lens, then *visibly* prints the enlargement.

But though this interesting process is occasionally shown at photographic gatherings, it is only, I believe, quite recently that suitable apparatus for the purpose has been purchasable. Mr. E. H. Hardy (late Government Surveyor, N.Z.) has shown me an efficient arrangement contrived by himself. The optical lantern of the apparatus is of the usual pattern, but a very ingenious portable easel has been specially designed for the process. To the opal panel of this easel the moistened bromide paper is made to adhere by suction, and is treated with a suitable sensitiser. The lens being then uncapped, the printing of the enlargement is clearly seen, and when the desired tint has been attained the lens is capped, and the print fixed, washed, and dried.

LANTERN SLIDES.

349. The printing of lantern slides, either by contact or by reduction in the camera, is an art of itself. The great aim in slide-making should be to keep the high lights pure and the shadows quite transparent, with every detail in them visible and clear. To obtain these qualities, and at the same time an agreeable colour, is by no means difficult; but to do so, three things are essential, viz., good negatives—sufficient exposure—comparatively weak developer.

Negatives for lantern slides need to be of the same quality as those for enlarging—see para. 340—and it is this necessity for sharpness that prevents so many hand-camera negatives from being suitable for making lantern slides.

It should also be remembered that slides required for an *oil* lantern need not be so intense as those for limelight.

SLIDES BY CONTACT PRINTING.

350. Special printing frames are desirable for making lantern slides by contact. These are so constructed that any selected portion of the negative can be printed from. Slides *may* be made in the ordinary frame used for paper prints, but in this case the lantern plate has each time to be adjusted over the part of the negative to be printed from—a tedious operation.

It will be found a good plan to have the opening in the printing frame made one-eighth of an inch smaller all round than the lantern plate—this will produce a clear glass margin of corresponding width, on which the slightest trace of fog will be clearly seen. This margin is ultimately covered by the mat and binding strip when the slide is mounted.

The light may be either a gas flame or an oil lamp, and it will be found best in practice to keep the flame uniform, and not to turn it either up or down, but, if necessary, to vary the distance between the negative and the light.

351. The length of exposure will depend upon the quickness of the plate, the quality of the negative, the nature of the light, and its distance from the negative. Other things being equal, the exposure is proportional to the square of the distance of the negative from the light—thus, if an exposure of ten seconds is required when the negative is one foot from the light, forty seconds will be required when it is two feet away, ninety seconds at three feet, and so on. Theoretically, this is correct, but practically it will be found that as the distance between the light and the negative increases so does the *penetrating* power of the light decrease below that which it should theoretically possess, and this will be found to be specially apparent in the case of that portion of the light which passes through the denser parts of the negative.

352. It will be manifest, therefore, that, to obtain the best results, the distance between the light and the printing frame must be adjusted to suit the *quality of the negative*—dense negatives being placed comparatively close to the light, ordinary negatives at a medium distance, and thin negatives farthest off.

353. As illustrating the above remarks, we will first take the case of a thin negative. If printed from at a distance of one foot from the gas or lamp the light will penetrate its weak deposit almost equally all over, and the result will be poor and useless. The same negative printed at two feet from the light with four times the former exposure will give a better result, and if finally printed from at three feet from the light (with nine times the exposure given at one foot) it will be found to produce a bright vigorous picture.

On the other hand, if a dense negative is printed from at three feet from the lamp, the light at that distance, having lost much of its penetrating power, will hardly affect the film under the denser portions of the negative, and the resulting picture will be hard; but if the same negative is placed within one foot of the light, and a suitable exposure given, a good result will be obtained.

354. In printing lantern slides, a *metronome* will be found far more convenient than the seconds hand of a watch. It will be understood that the metronome referred to is the instrument used by musicians for measuring time.

355. When the correct exposure for any negative has been ascertained, it should be marked on one of the corners of the plate, thus: "20″ at 1ft."

356. *Contact printing with magnesium.*—Slides may be readily printed either by day or night by exposing the printing frame to lighted magnesium ribbon. By day, this must be done in the dark-room. The length of ribbon to be burned will—like ordinary exposures—depend on the plate, the

negative, and the distance of the light. A few trials will show the length to be burned for the plates in use, but it may be stated approximately that for an ordinary negative at three feet, one inch of ribbon will be needed.

357. *Lantern plates*, for contact printing, are usually slow, and, like ordinary negative plates, show no visible image before development.

358. *Print-out lantern plates.*—Plates are now to be had which print-out like ordinary sensitive paper. For these special printing frames are made, but they may, if necessary, be printed in the ordinary frame used for paper. They must be printed in the sun, and should be exposed until the picture is *fully* visible on the *back* of the plate, and is of a deep ruby red colour. When printing thus in an ordinary frame the plate itself cannot, of course, be lifted for inspection (as can be done in the special frame), and the printing is, therefore, entirely judged from its appearance on *the back of the plate.* Print-out lantern plates are toned and treated in all respects like prints on ordinary sensitive paper. If slides on print-out plates should be accidentally under-exposed, they may be developed to proper density in the way recommended for gelatino-chloride prints—see para. 285.

359. A few hints for the treatment of Dr. Hill Norris's dry collodion lantern plates have been given in para. 84.

When properly worked, there is no difficulty whatever in getting adequate intensity with dry collodion plates. When sufficient density is not attained it is probably due either to over-exposure, or a too cold developer, or a weak light.

With dry collodion plates brightness of image is greatly influenced by the *power of the light;* the most brilliant slides are always the product of the most actinic light. Contrary to one's experience with gelatine plates, Dr. Norris finds that the weaker and thinner the negative the more intense (and closer) should be the light, and the shorter the exposure. Good results have been obtained with an exposure of a fraction of a second at six inches from an ordinary fish-tail gas burner.

For the above reasons, viz., the necessity for working dry collodion plates in a strong light, it is not desirable to attempt to make lantern slides by reduction in the camera *on dull days*, for it is not possible by length of exposure to compensate for the absence of brilliancy in the light—one is not, in this case, the equivalent of the other. A short exposure in a brilliant light is the main essential for good transparency work on dry collodion plates, particularly when the negatives are weak. Collodion positives may be toned a warm brown by bleaching with the ordinary mercurial solution (No. 21). After the usual thorough washing they are immersed in lime water. Dry collodion plates must be carefully handled during development, for they will not bear the rough usage which gelatine plates stand with impunity.

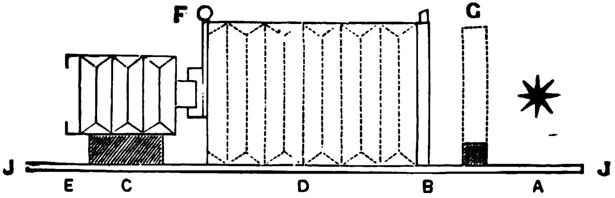
360. **Influence of exposure on the colour of the slide.**—The amount f exposure has a marked effect on the colour of the slide. The longer the xposure the warmer the tones. If a negative gives with one inch of agnesium ribbon at three feet a good brilliant black tone, with two or ree inches there will be a distinct tinge of red, and if an excessive amount f ribbon is burned the tone of the slide is altogether spoiled, and the same olds good for exposures to a gas flame or oil lamp. Experience alone will dicate the correct exposure, but let the exposure be sufficient.

SLIDE PRINTING IN THE CAMERA

361. **Many authorities consider that slides printed in the camera are better than those made by contact, especially if daylight is used instead of artificial light.**

The convenience to amateurs of contact printing is its great recommendation, but when the negative as a whole has to be reduced, the camera is indispensable.

There are many special patterns of cameras for making lantern slides, but to prove that the typical enlarging apparatus, shown at fig. 13, can also be used for reducing, the arrangement of the parts necessary for the purpose is given in fig. 17. It is manifest, however, that, except when reducing from very large negatives, the chamber (or camera) D need not be so big as that here shown, and that when working, as a rule, with small—say quarter-plate negatives, the special reducing cameras made for the purpose are more manageable and convenient.



Same apparatus arranged for REDUCING.

FIG. 17.

362. If working *by daylight*, no condenser is needed. The negative is placed in the carrier, film side towards the lens, and after being carefully focussed on the ground glass, the dark slide is inserted in its place. A sheet of ground glass being now placed in front of the negative, the apparatus is held or tilted towards the daylight, and the exposure made, but if the light comes direct from a clear sky, without clouds, trees, or other obstructions, the ground glass is not necessary.

As the actinic power of daylight is very variable, and is, moreover, very difficult to gauge correctly, an actinometer is almost indispensable. The method of using it must depend on the pattern selected.

363. For printing slides in the camera *by artificial light*, there is nothing better than an ordinary "Belge" lamp, fitted with a parabolic reflector—see pattern of lamp at A, fig. 16.

The distance from the light to the condenser, and from the condenser to the lens of the camera, will vary according to the size of the condenser selected, but with a half-plate condenser the lamp, turned up to its brightest, may be placed nine inches away.

The negative being placed in the carrier, film side towards the lens, and upside down, the small camera is now moved forwards or backwards, and the body racked in or out until a clear image of the required (lantern) size is obtained on the focussing screen. The dark slide is then inserted, and the exposure made.

364. Copying in the camera by *artificial* light is not generally considered so good as when *daylight* is used, but it makes it possible for many to work who are otherwise occupied during the day. A diffuser of ground glass may be placed between the condenser and the negative, but if opal is used instead of the ground glass the exposure is very greatly prolonged, and may be increased from six to ten times, according to the opacity of the opal.

365. When printing slides by reduction in the camera, the light is so much weaker than in contact printing that specially "*Rapid*" lantern plates are made for this purpose, so that the exposure may not be unduly protracted.

DEVELOPMENT OF LANTERN SLIDES.

366. A lantern slide must be very carefully developed with a suitable developer.

The emulsions used by the various makers of plates for *ordinary* negative work are so nearly the same that, as mentioned before, *any* average developer will give good results with most plates. But with lantern plates this does not hold good to the same extent, and the worker will generally do well to use the developer recommended for the particular lantern plate he is using.

For sky slides use the same developer as that with which the landscape portion of the slide was developed.

When developing in a room at a comfortable temperature (say 60°) the developer may be diluted with an equal bulk of water, but if the room is very cold, and the developers have not been warmed, they may be used with very little dilution.

367. A quinol developer should not be used at a low temperature; it is then almost inert. Eikonogen and amidol require to be used full strength in cold weather. Pyro developers can be used when the solutions are cold, as in winter; they give greater density at all times than the others. The solutions and developing dish may, of course, be warmed, but the results are not so certain as when one is able to work in a room with its contents at an uniformly warm temperature.

368. A good slide should permit the light to be visible through the very darkest portions. A good way to test a slide is to hold it to the light of a lamp fitted with a ground glass or opal shade. It should then appear perfectly transparent in the densest parts. The sky should be clear glass, nd every detail in the negative should be seen in the positive.

369. Use plenty of developer. Pyro developer must not be used for more than one plate, but the quinol, eikonogen, and similar developers may e used for two or three plates, but not more.

All lantern slides should be protected with a good cold varnish. Maw-on's "clear negative varnish" is recommended by many, and I have found t excellent.

370. When a lantern slide is not quite what it ought to be, it is best to throw it aside and make another. But a slide that is perfect in most respects, and is only wanting in depth of colour, may be treated with the mercury and *sulphite* intensifier, which, while not increasing its opacity, will probably improve its colour.

Over-developed slides may be softened by any suitable reducer, *used weak*.

Slides on the Hill Norris dry collodion plates, after being fixed and washed, may be intensified or re-developed by the following formula:

A.		B.	
Pyro	4 grains.	Silver nitrate	4 grains.
Glacial acetic acid ...	20 minims.	Nitric acid, 1, 420 ...	20 minims.
Distilled water	2 ounces.	Distilled water	2 ounces.

For use.—To each ounce of A add from thirty to sixty minims of B.

371. **Skies in lantern slides.**—If there are natural clouds in the negative which print in proper gradation with the rest of the landscape, no separate sky need be printed, but when such is not the case, skies are best printed on a separate sensitive plate, to be ultimately used instead of the ordinary plain covering glass. When the cloud negative and sensitive plate have been placed in the printing frame, the lower (landscape) portion of the plate may be roughly shielded by a suitable mask kept slightly moving during exposure, and any portion of the sky which may still be superfluous may be subsequently removed by a reducer. A rough guide to the exposure necessary is that at the same distance from the light as when printing the slide, one-sixth to one-tenth the time only is needed, according to the density of the cloud negative.

372. The method of obliterating the excess of sky is as follows:

When the sky plate has been fixed and slightly washed, prepare some of Farmer's reducer by placing one ounce of the hypo solution (No. 25 B) in a glass measure, and putting to it ten drops of a ten per cent. solution of ammonia, add sufficient of the ferricyanide solution (No. 25 A) to make the mixture a deep straw colour. Have ready a large and a small camel-hair brush on the opposite ends of the same handle—the small one for the reducer, and the large one for plain water. Now hold the landscape plate and the still moist sky plate *back to back*, and with the small brush dipped in the reducer go over that portion of the sky which encroaches on the landscape, and therefore needs removal. When the reducer has left its mark on the sky plate, lay aside the landscape plate and continue the action of the reducer till the surplus sky is all obliterated. The brush with water is to enable you to wash off any of the reducer that may spread to parts where it is not needed. Then wash the sky slide and dry it.

If at any time the reducer appears to lose power, and to become colourless, throw it away and make fresh. Do not add more ferricyanide to an exhausted solution. The ammonia is added to the reducer to prevent it staining.

If the sky is too heavy, pass the reducer over the whole of it, and wash off quickly.

373. The sky of the *finished* slide must be lighted from the same direction as the landscape with which it is conjoined. And here it must

not be forgotten that the plate on which the sky is printed, and which will be ultimately used instead of the ordinary plain cover glass, will be mounted *film to film* with the landscape plate, that consequently the lighting of the sky *will be reversed*, and that, therefore, for a landscape lighted from (say) the *right*, a sky negative must be selected in which the lighting comes from the *left.*

375. *Cover glasses for lantern slides.*—Most photographic plates for hand-camera work are now coated on *thin* glass, and a stock of spoiled negatives accumulates on the hands of even the most careful workers. A simple apparatus for cutting these quarter-plates down to lantern size for use as cover glasses is shown in fig. 18. By utilising old quarter-plates in this way, the cost of the glazier's diamond required for use with the apparatus will soon be covered, and the diamond will be found most convenient for making glass cutting shapes of special sizes, and numerous other purposes.

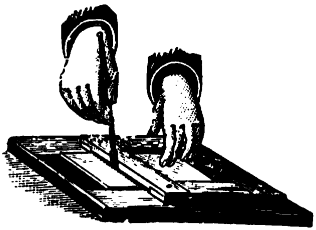


FIG. 18.

376. The paper binding-strips for lantern slides are sometimes unsatisfactory; they do not always adhere readily, and will not bear much manipulation. The *linen* binding strips recently introduced are a great improvement on the paper binders; they are more easily applied, and are far more lasting.

A liberal supply of mats of different sizes and shapes should be kept on hand, so that the one best suited to the slide may be selected. Where mats which are white on one side and black on the other are used, the white side should be uppermost, so as to face the operator when putting it into the lantern. Every slide should have two "spots" attached to its top edge; these will be lowermost when the slide is put into the lantern carrier. The numbers of the slides may be marked on these spots, and the title on the white mat.

377. Owing to the thinness of the emulsion on all lantern plates, it is difficult to see readily which is the *film* side. When looking at the unmounted slide, if the picture is right (that is, not reversed), the film is uppermost or towards you. If the glass surface of a lantern slide is breathed upon, it will show the condensed moisture, the film side will not.

378. For the benefit of the inexperienced, the routine of mounting a lantern slide is here given: (1) Carefully dust the slide and lay it down, film uppermost; (2) on it place the mat previously selected, white side uppermost; (3) over these lay the cover glass, well cleaned and dusted—if cloud cover glass is used, place it film downward; (4) then, having pre-ously damped a binder (a linen one by preference), lay it flat on a blotting d or other soft surface, place one side of the slide with its cover glass in e middle of the left end of the binder, and turn the slide over vertically l the binder has adhered to all four edges of the glasses, then press down e sides of the binder, snip the surplus from the corners, and lay the de aside to dry. After it is dry, it must be cleaned.

379. *Colouring lantern slides.*—Either oil or varnish colours may be used, but it is essential that they be transparent—opaque colours are quite unsuitable. The negative is first varnished, and is then placed on a retouching easel and suitably lighted. The colours are applied with fine sable brushes; broad tints, such as skies, are dabbed on with the finger tip, and graduated off with a badger-hair softener. The slide, when finished, is dried in a cool oven, or it may be even mounted with a cover glass at once, and will be found to dry satisfactorily. Take every precaution against dust. A few practical lessons from a professional colourist are invaluable—I might almost say indispensable.

380. *Dust.*—In every part of the process of making lantern slides, the utmost care must be taken *to avoid dust.* The washing water must be clear, the alum bath filtered, the drying must be done in a quiet corner, and the slides carefully dusted before mounting, for every speck of dust either adhering to the film or to the cover glass will appear greatly magnified in the picture on the screen. It has been recommended to lay a piece of stiff muslin over the plates when drying in the rack, to prevent dust settling on them.

TRANSPARENCIES.

381. The procedure for transparencies is identical with that given for lantern plates, except that the former must be developed to a much greater density.

When ground glass plates are not available for backing transparencies, ordinary glass flowed with mat varnish is a most efficient substitute.

FLASHLIGHT PHOTOGRAPHY.

382. Space will not admit of a detailed account of this process. The reader is referred to special treatises on the subject, and to various articles in the photographic periodicals.

There are many patterns of flash lamps, the simpler being often as good as the more elaborate. The main point is not only to have enough light, but to have it in the *right place.* Lamps made to burn pure magnesium powder should be used—the explosive mixtures of magnesium and chlorate of potash, etc., are dangerous in inexperienced hands.

CHAPTER XVI.—MISCELLANEOUS.

383. *Photographer's library.*—It is of no use to try to shut our eyes to the fact that photography is a somewhat expensive hobby, though at the same time it must be admitted that much of the cost of this interesting pursuit is due to failures owing to inexperience and ignorance.

Experience will be gained in time, but the period of ignorance may be materially shortened, and much expense indirectly saved, by a careful study of the best text-books, and of the periodical photographic publications. These are now so numerous that anything like a complete list would take up too much space; a few, however, may be here noted.

Burton's Modern Photography, 9th edition, 1890. 1s. An elementary work.

Abney's Instruction in Photography, 8th edition, 1888. 3s. 6d. A more advanced handbook, excellent in every way.

Chapman Jones's Introduction to the Science and Practice of Photography, 1888. 2s. 6d. One of the best of the text books.

Johnson's and Chatwood's Photography, Artistic and Scientific, 1895. An excellent manual.

Woodbury's Encyclopædia of Photography. 7s. 6d.

The Photographic Reference Book, by W. A. Watts, 1896. 6s.

Abney and Robinson's Art and Practice of Silver Printing, 1888. 2s. 6d.

Woodbury's Gelatino-chloride Printing. 2s.

Paget & Co.'s pamphlet on Silver Printing Papers. 6d.

Abney & Clark's Platinotype, 1895. 2s. 6d.

Lyonel Clark's Platinum Toning, 1890. 1s.

The A B C Guide to Autotype (Carbon) Processes, 1887. 2s. 6d.

Elliott & Son's pamphlet on the Carbon Process. Free.

Lund's Drop-shutter Photography, Indoor Photography, Developers, Retouching, etc. 6d. each. *(Popular Photographic Series.)*

Emerson's Naturalistic Photography, 1889. 5s.

Meldola's Chemistry of Photography, 1891. *(Nature Series.)*

Welford's Hand Camera, and How to Use it, 1892. 1s.

C. G. Harper's Handbook of Drawing for Reproduction, 1894.

Waterhouse on the Photographic Reproduction of Drawings, 1890. 5s.

Ward's Practical Ferrotype. 9d.

Dresser's Lantern Slides, and How to Make them. 6d.

Wheeler's Photographic Enlargements. 1s.

Wright's Optical Projection.

Slingby's Practical Flash-light Photography. 4s.

Johnson's Art of Retouching. 2s.

Lund's A B C of Retouching, 1896. 6d.

Bools's Photographic Painting. 1s.

The Photographic Colourist, by Neville. (Tylar.) 6d.

Schnauss's Collotype and Photo-lithography, translated by Middleton 5s.

Burnet's Practical Essays on Art (P Lund), 1893. 2s. 6d.
Robinson's Pictorial Effect in Photography, 1885. 2s. 6d.
" Art Photography, 1890. 1s.
" Studio, and What to Do in it, 1891. 2s. 6d.
" Elements of a Pictorial Photograph, 1896.
Duchochois's Lighting in Photographic Studios, 1895. 1s.
Wall's Artistic Landscape Photography, 1896. 3s. 6d.
Maclean's Photography for Artists, 1896. 2s.

Ward's Practical Radiography, 1896. 1s.
Thornton—The X Rays (P. Lund), 1896. 6d.

384. *The photographer's every-day book.*—In the periodical photographic literature there are many original articles and items of correspondence embodying valuable information which are liable to be lost sight of unless extracted, or at least indexed. A notebook is, therefore, essential to every photographer who wishes to keep abreast of the latest development of the art.

Much of the ease with which the book can be kept up will depend on its method of arrangement. Perhaps the best plan is to select a favourite text-book, to have it interleaved and rebound, and to enter notes as they occur opposite the corresponding items in the text-book. These notes may be either literal transcripts or mere references to the source where the information is to be found.

385. *Proportional scale.*—It is occasionally necessary to photograph plans, pictures, or botanical specimens to scale. For this purpose a frame with fine wires or strings crossing at equal distances is used. When a print has to be either reduced or enlarged and reproduced by engraving or any other hand process the apparatus may be placed over the negative when being printed from, and the resulting print will be marked with white lines, which will be of great assistance to the engraver. Many other obvious uses of such a "proportional scale" will suggest themselves.

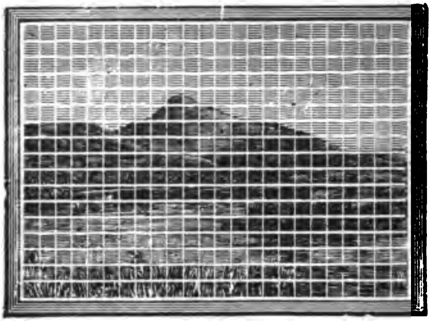


FIG. 19.

USEFUL DATA.

386. *Sizes of continental gelatine plates.*—**The following sizes are those most generally in use on the Continent. There are other plates of special dimensions which it is not necessary to specify:**

Centimetres	9 × 12	equal to inches	3·54 × 4·72
,,	13 × 18	,, ,,	5·11 × 7·08
,,	15 × 21	,, ,,	5·90 × 8·27
,,	18 × 24	,, ,,	7·08 × 9·44
,,	21 × 27	,, ,,	8·27 × 10·62
,,	24 × 30	,, ,,	9·44 × 11·81
,,	30 × 40	,, ,,	11·81 × 15·75

Sizes of mounts.—The sizes most used by non-professionals are as follow, but there are many others. The names given to the sizes are arbitrary. Stereoscopic pictures *must* be mounted on cards of the dimensions specified:

Stereoscopic pictures		inches	7 × 3 7/16
Quarter-plate (landscape)		,,	7 × 5
Cabinet (portrait)		,,	6½ × 4¼
Half-plate	Small	,,	6½ × 4¾
	Large (or 8½ × 6½)	,,	8 × 6
Whole-plate	Small	,,	10 × 8
	Large	,,	12 × 10

388. **Decimal measures and weights.**—These are used by almost all the nations on the continent of Europe.

Linear { 1 metre = 39·37 inches.
1 centimetre = ·3937 inches.

Capacity { 1 litre = 35 fluid ounces.
1 cubic centimetre = 17 minims.

Weight { 1 kilogramme = 2·2046 lbs.
1 gramme = 15·432 grains (or rather more than ¼ dram .

389. *Conversion of English into decimal measures and weights.*

Linear { 1 foot = 30·48 centimetres.
1 inch = 2·54 centimetres.

Capacity { 1 pint = 568 cubic centimetres.
1 fluid ounce = 28·4 cubic centimetres.
1 minim = ·472 cubic centimetres.

Weight { 1 ounce (480 grains) =31·104 grammes.
1 grain = ·0648 grammes.

An English gold sovereign weighs eight *grammes*, a half-crown piece about fourteen *grammes*, and a bronze penny is only three grains less than ten *grammes*.

The diameter of an English farthing is exactly two centimetres, and a penny is a small fraction over three centimetres.

The diameter of an English halfpenny is exactly one inch.—*British Journal of Photography*.

390. A table showing the angle subtended by a lens on a plate of given size is appended for convenient reference:

Focus of Lens in Inches.	SIZE OF PLATE IN INCHES.									
	4¼ × 3¼	5 × 4	6½ × 4¾	7½ × 4½	8 × 5	8½ × 6½	9 × 7	10 × 8	12 × 10	15 × 12
3	74°	79°	97°							
4	58°	64°	78°	86°						
5	48°	53°	62°	74°	77°	81°	84°			
6	41°	45°	53°	64°	68°	70°	73°	79°		
7	36°	39°	50°	56°	59°	62°	65°	71°	81°	
8	31°	35°	44°	50°	53°	56°	59°	64°	74°	84°
9	28°	31°	40°	45°	48°	51°	53°	58°	67°	80°
10	24°	28°	38°	41°	44°	46°	49°	53°	62°	74°
11	22°	26°	33°	38°	40°	42°	44°	49°	57°	69°
12	20°	24°	30°	35°	37°	39°	41°	45°	53°	64°
13	19°	22°	28°	32°	34°	35°	38°	42°	50°	59°
14		20°	26°	30°	32°	34°	36°	39°	46°	56°
15		19°	24°	28°	30°	32°	33°	37°	44°	53°
16			22°	26°	28°	30°	31°	35°	41°	50°
17			20°	25°	26°	28°	30°	33°	39°	48°
18			19°	23°	25°	26°	28°	31°	37°	45°

391. **Labels for sensitive plates.**—Mr. W. E. Woodbury gives in the *Amateur Photographer* the following forms of label in various languages:

English.—Sensitive photographic plates, which will be quite spoilt if opened in the light. Only to be opened in a totally dark room or by a red light.

French.—Plaques photographiques sensibles. Tout détruites par l'exposition à la lumière. Prendre garde de n'ouvrir la boîte que dans une chambre parfaitement obscure.

German.—Photographische Trockenplatten Sehr lichtempfindlich Werden ganz verdorben, wenn dem Lichte ausgesetzt Mussen nur in absolut dunkelm Zimmer oder bei rothem Lichte geöffnet werden.

Spanish.—Las placas fotograficas sensitivas, que se inutilizan si se las expone al abrirlas, à la luz del dia, se pueden abrir sin inconvenientes en una habitacion enteramente oscura o iluminada por luz roja.

Portuguese.—Laminas photographicas sensitivas. Nao podem ser expostas á luz porque se inutilisam; popendo só ser abertas em camara escura oce com luz vermelho.

Dutch.—Chemisch tocbereide photographische platen weke gehue bedorven worden als zy aan de lucus worden blaatgeshild. Alleen te openen in eene donkere kamer of by rood licht.

Italian.—Piastro fotografiche sensitive che si simperanno affatto se esposte alla luce del giorno. Da aprirsi solo in una stanza affatto buja o dove regni una luce rossa.

Norwegian.—Fölsomme fotografiske Plader, som fuldstandig fordœrves ved at udsottes for Lyset. B'or knn aabnes i et aldeles morkt Rum eller ved rödt Lys.

Swedish.—Sjuskäushga fotografiska plätar, blivfa förstörda om de uttsattas för ljus. Fas derföre ej öppuas utom i ett absolut mörkt rum.

Greek.—*Ωίν εὐάνοδηζοι φωτογραφμαί πτάμες αἴζινη δα φδαρωσιν ἄν ἀνοιχδωσιν εν α τῳ φωτί. Δέου νά ἀνοιχδωσιν ἐν συωτενν' ῳ δωματίαν, ἢ μέφᾶς ἐρυδροῦν.*

392. By the courtesy of A. Watkins, Esq., I am permitted to publish his latest list of the relative speed of photographic plates. This list is *copyright*, and is specially prepared for use with the Watkins "Exposure Meter." My object in introducing it is that it may afford a ready guide to those who, when on tour, may happen to run out of the plates they are in the habit of using, and may have to work with any odd packets of unfamiliar brands which they can obtain locally.

Relative speed list for use with the Watkins exposure meter, compiled from actual tests in the camera by Alfred Watkins.

Caution.—The speed of different batches of the same maker's plate often varies enormously. It must by no means be presumed that the "quickest" plates on this list are the best for hand-camera work; quality cannot be expressed in figures.

	P.		P.
Austin Edwards' Ordinary	60	Imperial Extreme Rapidity	120
" " Double Instant.	120	Lumière Rapid	100
" " Instantaneous	100	*Marion's Plates X 1½	
Barnet Ordinary	60	Mawson	150
" Studio	70	" Castle	70
" Extra Rapid	80	" Electric	100
" Rocket	150	Paget XXX	60
Beernaert Extra Rapid	100	" XXXX	150
*Cadett's Plates X 1¼		" Phœnix	40
Eastman Film	50	Sandell, Landscape	10
Edwards' Spec. Portrait	75	" Ordinary	40
" Snap Shot	150	" Special Express	80
" Medium Iso	35	Smith Tourist	70
" Inst. Iso.	70	Thomas, Landscape, Common	50
Fitch Films, Ordinary	25	" Ex. Rapid	70
" " Extra Rapid	60	" A1	150
Hill Norris, Dry Collodion Medium	5	" Ultra	150
Ilford Ordinary	35	Verel, Runaway	120
" Empress	80	" Cathcart Ex. R.	90
" Spec. Rapid	150	" Cathcart	35
" Medium Iso	35	Wratten, Ordinary	12
*Imperial X1	30	" Instantaneous	60
" Extra Rapid	60	" Drop Shutter	120

* These plates are marked with H & D speed numbers, which multiplied by the value opposite each gives the P number. Thus Cadett's marked 100 = P. 125.

LANTERN PLATES. P. NUMBERS.

Thomas	2	Mawson	2
Ilford Spec.	6	Edwards' Spec.	3
Eastman	6	Hill Norris Collodion	8
Cadett	3	Carbutt, A.	18
Imperial Special	15	Paget Rapid	15
" Slow	4	" Slow	6
Barnet	12	Queen	12

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Eastman's Transfero	6	Morgan & Kidd	15
" Permanent Slow	6	Anthony Rapid	50
" Hard Enamel	6	Ilford Slow	3
" Nikko	6	" Rapid	30
" Ex. Rapid (Eng.)	30	Dr. Just	4
" Extra Quick	20	Mawson	6
" Soft Enamel	20	Barnet	40
" Platino-bromide	30	Wellington	30

RECIPES, &c.

393. *Mat varnish* is used for applying to portions of the glass side of a weak negative to improve its printing qualities, and its effect is heightened if it is coloured with some red or orange dye.

No. 44.—Mat (or ground-glass) varnish (Burton and Pringle's).

Sandarac	90 grains.
Mastic	20 ,,
Ether (methylated)	2 ounces.

Dissolve, and add ½ to 1½ ounces benzole.

The proportion of benzole determines the nature of the mat; the greater proportion of benzole, the finer the mat surface. For the purpose alluded to in para. 210, this varnish may be coloured with a concentrated decoction of alkenet in ether, until the desired tint is obtained.*

394. *Retouching varnish* is applied to the film side of the negative to enable the retouching pencil to bite.

No. 45.—Negative retouching varnish.

Sandarac	1 ounce.
Castor oil	80 grains.
Methylated spirit	6 ounces.

First dissolve the sandarac in the alcohol, and then add the castor oil. Almost any spirit varnish may be converted into a fairly good retouching varnish by adding from three-quarters to one ounce of castor oil to each quart of varnish.

395. *Celluloid varnish* is a clear quick-drying solution which can be flowed over the negative, and needs no heat. It is sold by many dealers under various names. It must *not* be used for *films*, as the solvent would attack the celluloid. The following formula is given by Mr. Mitchell:

No. 46.—Celluloid varnish.

Amyl acetate	1 part.
Petroleum benzine	1 ,,
Alcohol	3 parts.
Ether	3 ,,
Celluloid q.s.	

Old celluloid films, after being well cleaned, are cut up into strips, put in a bottle with the above solvents. The celluloid swells up and dissolves rather slowly, hence the bottle containing the mixture should be well shaken at intervals during several days. When the celluloid is all dissolved, the liquid should be filtered through a little absorbent cotton to remove any loose flecks of dirt.

396. *Pyroxyline varnish.*—The formula here given appears to be that of the varnish sold under the name of "*Zapon.*"

No. 47.—Pyroxyline varnish.

Pyroxyline	100 grains.
Amyl acetate	10 ounces.

This varnish is said to take many hours to dry, but gives a hard film.

396A. *Zaponlac.*—The following is recommended as a varnish for stiff films or coating metal objects:

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* These formulæ for varnishes are given for the use of photographers abroad who may not be able to procure them ready-made. As a general rule, varnishes can be purchased more cheaply than they can be made.

Acetate of amyl	175 parts.
Benzole	175 ,,
Acetone	87 ,,
Pyroxyline	12½ ,,

397. *Cold sandarac varnish.*—Dr. Valenta has published an excellent article on photographic varnishes. One formula which he specially recommends is here given—see *Photography*, 1893, page 593.

No 48.—Valenta's cold sandarac varnish.

Sandarac	100 grammes	=	3½ ounces.
Benzole	400 c.c.	=	14 fluid ounces.
Acetone	400 c.c.	=	14 ,, ,,
Absolute alcohol	200 c.c.	=	7 ,, ,,

This mixture should be very carefully heated over a water bath, and then filtered through paper. It gives a clear quick-drying film, harder than that furnished by the ordinary benzole cold varnishes.

398. *Lac varnish for woodwork.*—The wood should be quite dry, and the varnish applied in a warm room.

No. 49.—Lac varnish for woodwork.

Shell-lac	4 ounces
Wood naphtha	20 ,,

Dissolve without heat, shaking occasionally. For very fine work, the clear liquid may be decanted from the sediment, but for coarse articles the whole may be shaken up together.

399. *Toning without gold.*—It may be sometimes necessary to prepare a presentable print for temporary purposes when circumstances do not admit of the use of the usual gold toning bath. This may be done by printing somewhat deeply, and passing the print direct from the printing frame (without washing) into the *acid* fixing bath (No. 16). Or the ordinary fixing bath (hypo 1, water 5) may be taken, and sulphuric or acetic acid added by slow degrees, with constant stirring, until opalescence appears. Prints thus treated attain a pleasant chocolate brown colour, due entirely to *sulphur* toning.

400. *Yellow screens for orthochromatic work.*—Col. Waterhouse points out that clear thin mica or talc, suitably coloured, may be used instead of yellow glass. The mica plate is coated with a cold-drying crystal varnish, consisting of a solution of sandarac or dammar in benzine, and coloured with turmeric (greenish yellow), or annatto (reddish yellow), or kamala (neutral yellow). A good mixture is turmeric varnish 2 parts, annatto varnish 1 part, kamala varnish 1 part. Different tints can, of course, be obtained by varying the proportions—see para. 78.

401. *Printing from a scratched negative.*—It often happens that the glass side of a negative has large scratches on it, which show on the print, and it has been recommended to print such negatives with a "roasting jack" arrangement. If, however, the scratches be carefully cleaned and then filled up with Canada balsam thinned in benzole or chloroform, or, better still, in xylol, when dry the print will show no trace of the scratch, the refractive index of balsam being very nearly that of glass. Of course, scratches on the film are fatal, and if large are never satisfactorily remedied.

401A. *Printing from a cracked negative.*—Lay the broken negative on a piece of glass of the same size, bind the two edges together, as is done with lantern slides, dust the whole negative over with finely-powdered blacklead, so as to fill in the cracks, brush off the surplus blacklead, and print. With a little subsequent spotting, a passable print may generally be obtained.

402. *Dextrine paste.*—Mix four tablespoonsful of powdered dextrine with two ounces of cold water, and rub it to a smooth paste, then add by degrees four ounces of methylated spirit.

403. *Burnishing paste.*—Castile soap 4 grains, alcohol 1 ounce. Heat the mixture by putting the bottle in hot water, leaving the cork somewhat loose to prevent its bursting. When the solution is complete, cork tightly.

404. *Cleaning bottles or vessels.*—A bottle is often wanted in a hurry, and a clean one is not always at hand. When this is the case, first wash the doubtful bottle in water, and then put into it *a little of the solution it is intended to contain*, fill up with water, shake thoroughly, and, if possible, let it soak for a while, then pour away this dilute solution, which will have neutralised any impurity, and the bottle may then (without drying) be safely filled with the solution required.

405. *Tight stoppers.*—The glass stoppers of bottles used for photographic solutions are very liable to stick fast. To prevent this, rub the dry glass stopper with a trace of vaseline.

The corks of varnish bottles are also liable to become fixed, owing to the drying of the varnish round the mouth. A trace of vaseline smeared on the cork will prevent this, but a preferable plan is to soak the cork in melted paraffin. This may be done with advantage to the corks of bottles containing other liquid besides varnish, as it fills up the pores of the corks and makes them air-tight and waterproof. No photographic chemicals are affected by either vaseline or paraffin.

406. *Labels* are very liable to come off. To prevent this, smear the label when dry with a little boiled linseed oil or copal varnish.

407. *To remove developer stains from the fingers.*—Apply a saturated solution of chloride of lime, and follow with citric acid in crystals. Or mix hydrochloric acid 50 parts, oxalic acid 10 parts, phosphoric acid 10 parts, with 100 parts of water. Oxalic acid alone is efficient, so also is a ten per cent. solution of hydrochloric acid. The hands must be well rinsed after using any of these preparations, all of which are more or less poisonous. Or the stains may be touched with a weak solution of iodine, which, after five minutes, is washed off with ammonia.

Stains on linen.—Moisten the stain, and rub well into it salts of lemon (oxalic acid), lay the article aside for several hours, occasionally damping it, then wash out the oxalic acid, which is a strong poison.

408. *Silver stains on negatives.*—If the printing paper is found to have stuck to a negative, do not attempt to tear it off or to moisten the paper, which would only increase the size of the stain, but after cutting off the portions of paper which have not adhered, put the negative straight into the hypo bath, which will dissolve out the silver and release the paper.

409. *Substitutes for focussing screens.*—A sensitive plate is exposed for the smallest possible time to diffused daylight, and then developed, fixed, and washed. It must be placed in the camera with the film inwards.

A clean glass flowed with mat varnish is also a good substitute.

410. *Celluloid articles, to mend.*—Touch the severed edges with the strongest (glacial) acetic acid, and press into close contact till dry.

411. *Residues.*—To the washing waters, *before toning*, add hydrochloric acid or common salt. To old fixing baths add sulphide of potash (liver of sulphur), which throws down the silver as a black powder; or stand a plate of copper in the old hypo bath for several days—on this plate the silver will be deposited in a black powder.

412. *Cleaning silver reflectors.*—A bit of chamois leather dipped in an old hypo bath, which has been used to fix negatives. This will also silver any surface of copper on which it is rubbed.

413. *To dry a negative quickly.*—"Remove the negative from the washing water, drain, and then lay a clean *linen* fabric—a cambric pocket handkerchief answers well—on the film side, place a sheet of paper over this, and then press the linen well into contact with the gelatine with a soft roller squeegee. On removing the linen, it will be seen that almost all the moisture has been taken out of the film, which will then dry in a very short time."—*Photographic News.*

414. *To remove the films from old negatives.*—Soak for a day or two in common vinegar or dilute acetic acid, and then scrape off the film with a slip of wood.

RADIOGRAPHY.

PHOTOGRAPHY WITH THE X RAYS.

By J. Hall-Edwards, L.R.C.P., F.R.P.S.

In a volume like the present one, which attempts as far as possible to cover the whole ground of photographic procedure, it is an absolute necessity that some mention should be made of the latest discovery in the field of science. Although the discovery cannot in truth be called a photographic one, the various applications of the X rays, which have been made by means of their photographic action, are of such importance and universal benefit that a few short notes upon the subject must prove acceptable to the large body of photographers who peruse the pages of "The Nutshell."

In dealing with the subject in hand I shall take it for granted that my readers are not wholly unacquainted with either the apparatus or of the methods of procedure necessary for the production of radiographs.

History.—In the year 1816, Faraday (who was but a student of twenty-four years of age), in a series of lectures on the general properties of matter, hypothesised that matter was capable of existing in a state which was as far removed from a gas as a gas is from a liquid, and that the properties of this new condition, which he called radiant matter, would be found to differ very materially from those usually exhibited by a gas. In August, 1879, William Crookes, F.R.S., demonstrated before a meeting of the British Association for the Advancement of Science, at Sheffield, that, after a prolonged research, he had discovered radiant matter, and in a masterly paper proved that such matter exhibited properties hitherto unknown. He constructed a number of various shaped glass tubes, each having carried into their interior metallic poles capable of carrying the current from an induction coil. When the pressure of the air or gas contained in these tubes had been reduced by means of a mercury pump to about the one one-millionth of an atmosphere, and an intermittent high tension current was passed through them, they exhibited phenomena which were new. Mr. Crookes ended his paper as follows: "We have actually touched the borderland where Matter and Force seem to merge into one another, the shadowy realm between known and unknown, which for me has always had peculiar temptations. I venture to think that the greatest scientific problems of the future will find their solution in this borderland, and even beyond; here, it seems to me, lie ultimate realities—subtle, far-reaching, wonderful." Although it is but a few years since Crookes ventured to predict, we have, as an outcome of further experiment in this direction, now at our command a force which not only has upset all our preconceived ideas, but which has already proved itself of great service in our hands. Continued experiment taught Hertz, Lenard, and others that the rays which proceeded from the cathode pole had the property of being able to pass through substances ordinarily considered opaque; also that of producing fluorescence in certain substances brought into their path. It was whilst experimenting in this direction that Professor Röntgen discovered that if a solid body be brought into the path of the cathode stream, a new set of rays are produced from the solid surface. These rays differ in many and important respects from the cathode rays, not the least being that they cannot be bent from their path by the most powerful magnet. They have in addition greater penetrative and fluorescence-producing powers. As the character of these rays was unknown, Professor Röntgen christened them X rays (X being the mathematician's sign for an unknown quantity). The only advance made by Röntgen lay in the fact that he accidentally discovered that the X rays had the power of producing a developable image upon a photographic plate. Had Lenard tried such a plate in his experiments, we should years ago have had the force at our command. The chief interest in the discovery from a popular point of view lies in the fact that whilst the rays pass with the greatest ease through flesh, they are stopped to an extent by the lime salts contained in bone; hence the skeleton can be outlined through the living flesh.

Since a translation of Professor Röntgen's masterly paper was first published in this country, in January, 1896, nothing new has been added, and, although the photographic results to-day show a considerable improvement upon the first productions, this has been brought about rather by increased experience than by further discovery.

It is impossible in the small space placed at my disposal to enter deeply upon the interesting and fascinating subject in hand. I shall, therefore, assume that my readers have a certain amount of knowledge, and shall at once proceed to the necessary apparatus and the various purely photographic procedures in connection with the subject.

Apparatus Required.—In dealing with this subject I necessarily leave out of my list all the purely photographic requisites, as I assume you have these already at hand. The only necessary apparatus to the photographer may be discussed under the following headings:

The source of electricity.
The coil.
Tubes.
Tube holder, etc.
Photographic requisites.

The Source of Electricity.—Should you be fortunate enough to have at hand a direct supply from the local electrical supply company, I advise you not to use it, for the simple reason that even under the most favourable circumstances it is wasteful. The largest coils in existence require but a small current, hence to adapt the supply company's mains to your service means great waste. The amount of resistance which is requisite before the high voltage of the supply can be cut down to suit your purpose is enormous, and even should you be fortunate enough to be able to use this with advantage, I doubt that you may not do better. Should, however, you be rich and indolent, any practical electrician can supply you (at a price) with a complete arrangement which will regularly give you the desired amount of current with a minimum of trouble, and at a moment's notice. Primary batteries I cannot advise, that is, if you wish more than to occasionally experiment. In the first place they are a source of great trouble, in addition to being smelly and dirty. The best of them rapidly run down, and they require constant care and attention if they are to be kept in working order.

For practical work, cleanliness, and easy manipulation, there is nothing to touch storage batteries or accumulators. These certainly require recharging at intervals, but this will be undertaken by any electric supply company at a very small charge. If you are doing constant work it will, of course, be necessary to have two of these instruments, so that one can be at the charging station whilst the other is in use. It is not my intention to advise any special make of accumulator; these instruments have been so much improved during the last few years that any reliable maker will provide one suitable for the purpose, granting that you supply him with the capacity of your coil. (This should be obtained from the manufacturer.) Accumulators, if used with care and pretty regularly, should last for several years; but if they are to be kept in first-class condition, they must be used and charged at regular intervals. They must be handled with care, and on no account must they be dropped or bumped. Experimenters who reside in country districts will either have to charge their own instruments from primary batteries, or they must provide themselves with special makes which can with safety be transmitted by rail.

To those who have steam power at their disposal, a small dynamo is the best source of electricity, but those who are in a position to avail themselves of this luxury must be few and far between.

The only method of generating current I have not touched upon is the Wimshurst induction machine. Several experimenters have spoken in the highest terms of this method, but the slowness with which the sparks are produced, added to the exertion necessary for their production, must ever mitigate its general adoption.

The Coil.—Without doubt the most important piece of apparatus is the coil. There are coils and coils—good, bad, and indifferent. It is absolutely impossible to tell a good instrument from inspection; a lengthy trial being the only test. This being the case it behoves one to purchase with care, and in the best market. For ordinary work (even medical) a coil which will give a continuous four to six inch spark is all that is required, although a larger instrument has distinct advantages. For small experiments where the time of exposure is a matter of small importance, a two-inch spark will yield splendid results.

For the smaller instruments a platinum spring contact breaker is sufficient, but for the larger ones (which give sparks above five inches in length) some form of mercury interrupter is almost a necessity, otherwise work will have to be continually abandoned in order that the platinum connections may be renewed. The platinum interrupter certainly has advantages, inasmuch as it is not only cleaner, but the interruptions are much more rapid, and, as a consequence, the exposure is rendered shorter. The degree of finish of a coil does not help one in the least in forming an opinion of its capabilities—the main factors are perfect insulation, and a knowledge that the various parts have been built in their proper proportions.

A well-planned and carefully-insulated coil is an instrument to be proud of, for many which at first give splendid results suddenly become useless through some imperfection in their insulation. Since the publication of Röntgen's discovery, numberless inferior coils have been placed upon the market; these can never give satisfaction, hence the best advice I can give is that one should be purchased from a maker whose name is a guarantee of good workmanship.

The instrument should be kept in a warm room, and should be protected from sudden changes of temperature.

Tubes.—The only real advance made in radiography since its discovery is in the manufacture of tubes. At first they were too small, hence they soon sparked over, and the poles were so constructed that stray sparks were tempted to pierce the glass, and this rendered them useless. Experience and experiment have both helped to overcome this difficulty, and at the present time they are not only much more efficient, but their lives have been considerably lengthened. In the first tubes the cathode rays were projected upon the glass itself, and the X rays started therefrom; as a consequence the image produced was diffused, and lacked the sharpness which is seen in the later productions. I may here state that it can now be proved with certainty that the X rays start from the point struck by the cathode rays.

The introduction of the so-called focus tube marked the first advance, and some modification of this principle is now generally adopted. Of various forms of focus tubes we now have many, and there will necessarily be some difficulty for the beginner in deciding which to purchase. In my experience I have always found a large tube yield the best results. A good tube should be of such a length or size that it is impossible for the spark used to jump over, even should the vacuum become so high that it refuses to pass through. Failing this it should be of such a shape that the spark can pass from one terminal to another without having to pass over the surface of the glass, as this passage of sparks constitutes a great source of danger. The tube should be so constructed that by reversing the current the vacuum can be lowered, that is to say, the platinum "reflector" should be capable of being used as one of the poles, even should it during working not be used as such. The poles should be placed well in the bulb, or should be protected by an independent cup-shaped glass covering from the walls of the tube. This is necessary from the fact that, during working, small particles of metal are cast off from the cathode pole with such violence that they not infrequently produce small cracks in the glass; these are easily detected by the brilliancy produced when the spark passes. It is through these microscopic cracks that the sparks have a great tendency to pass, especially when the edge of the aluminium disc with which the pole is usually constructed is placed near the surface of the tube.

The thin platinum wire loops which were first used to connect the tubes with the coil have now been discarded in favour of more substantial ones of either aluminium or brass. This is a matter of no small importance, as formerly these fragile connections were for ever breaking off, when it required the assistance of an expert to repair them.

After use, tubes should be carefully packed away in a box with cotton wool or fine shavings. Should the vacuum become so high that sparks refuse to pass, there are two ways in which it can be lowered—in the tubes I have recommended this can be best done by reversing the current for a time; in patterns where the platinum "reflector" cannot be brought into circuit, the only method is by warming them. This is generally done by means of a spirit lamp or small Bunsen burner, and some care is required lest unequal heating should cause them to crack. I find the best and safest method is to suspend them by means of a piece of cotton or thread before a bright hot fire, when they can be so twisted about that unequal heating is impossible.

As a secondary safeguard against sparks passing through or passing over the surface of the tube, I find it a good plan to cover the whole of the tube, with the exception of the globe, with a good varnish composed of shellac in spirit.

Tube Holder, etc.—Several special holders have been designed to keep in position special forms of tubes. I have found, however, that the universal wooden holder, which can be obtained from any dealer in chemical apparatus, is far more useful than any other arrangement so far designed. If it is necessary to carry your connecting wires some distance from your coil, I find a T stand very useful. This is best made of wood or vulcanite, but it may be made of brass, granting that the wires are suspended from the arms by silk threads of such a length as not to admit of the spark jumping across the brass.

Photographic Requisites.—Apart from the necessaries to the ordinary photographer, all of which I take for granted are in the possession of our readers, the only necessity is a stock of light-tight envelopes in which to place the plates during the process of exposure.

Those I find best for the purpose are such as are supplied by Mr. Tylar for the carrying of unexposed and undeveloped plates. The plate is first put into a yellow envelope made of chemically-pure paper, and this is again inserted in a thick black envelope made of special paper free from pinholes.

Having all the apparatus in order, I will now describe the methods of procedure under the following headings:

Arrangement of apparatus.
Arrangement of subjects.
Exposure.
Development.
Printing.

Arrangement of Apparatus.—It is well to place the coil upon a table of such a size as to allow plenty of room, not only for the various pieces of necessary apparatus I have already described, but also for the plates and any small object you may wish to radiograph. The leading wires from the coil to the tube, or sparkers, are best made of flexible, silk-covered wire, and they should be sufficiently long to reach over the table to the floor of the room in case they should be required to do so. During the radiographing of small objects, these wires can be looped up (so as to be out of the way) in the silk cords which hang from the arms of the T stand already described. If the coil be supplied with a separate pair of sparkers, it is best to connect the leading wires to these, and to connect the sparkers with the tube by means of coiled, silk-covered, thin copper wire. If, however, the sparkers are attached to the coil stand—or if there be none—the leading wires may be connected directly with the tube, some such arrangement as the T stand I have described being used to hold them in position.

The tube is held in position in the universal holder described, and great care should be taken that the platinum "reflector" is so arranged as to project the X rays straight upon the plate, otherwise (if the object to be radiographed be thick) there is certain to be some distortion. Care should also be taken that the tube be placed at such a distance from the object as will render it impossible for sparks to pass from the terminals through the part to be radiographed. This point must be particularly attended to when radiographing living bones, otherwise such an accident may mean considerable damage to apparatus, owing to the jumping of the subject when the spark passes.

The proper distance between the platinum "reflector" and the plate when radiographing a hand is from eight to ten inches. If it is placed nearer, the bones will be enlarged, and if further away, the time of exposure will be unnecessarily prolonged. It must be remembered that the X rays start from the surface of the platinum, and that their intensity varies inversely with the square of the distance between it and the photographic plate.

Arrangement of Subject.—The sensitive plate placed in the envelopes already described should be arranged upon the table underneath the tube, the platinum "reflector" being placed over the centre of the plate. In radiographing small objects, these are simply arranged on the plate prior to the turning on of the current. Should the objects be of such a shape that they are liable to move, they may be kept in position by fixing them with strips of gummed lantern-slide binding. This arrangement is also useful when it is found necessary to fix the plate in any position other than flat upon the table.

In radiographing human limbs, the part should be placed as flat upon the plate as possible, and care should be taken that the subject is made as comfortable as possible, so as to obviate all chance of movement during the operation. It must be remembered that although the whole thickness of a bone is figured in the image, that portion of the bone which is nearest to the sensitive surface shows the greatest amount of detail, hence in many cases it is necessary to take both sides of a limb before a satisfactory conclusion can be arrived at. This necessitates a lot of manœuvring, and to the surgical-radiographer a flat hard sofa, upon which the subject and plate can be arranged, is an absolute necessity. In radiographing through some objects, the plate has to be held in all sorts of positions; for this purpose a spare universal holder will prove useful. In all cases it must be remembered that the image is only a shadow, hence all objects must be placed as close to the plate as possible.

Exposure.—The length of exposure necessary to produce a desired result can only be judged by experience. It depends upon the amount of primary current, the length and volume of spark, the degree of exhaustion and size of tube, and the sensitiveness of the photographic plate used; in addition to the distance of the tube from the plate which I have already mentioned.

There are at least two methods of testing the actinic power of the rays and of finding out the shortest exposure necessary for producing a negative upon a given make of plate: The first is by using a Rayometer—an instrument formed of superimposed layers of thin metal of diminishing size, which I first described in the columns of *Photography* of June 4th, 1896. This instrument should be exposed under the tube at the same time as some other object it is your wish to radiograph. The number of thicknesses of the metal penetrated by the X rays can be easily noted, and in trying a new arrangement, tube, or plate, a preliminary experiment with the Rayometer will be of great service in helping you to form an opinion of the actinic power of the rays.

The second method is carried out as follows: The protecting cover of the plate is ruled across with lines at a given distance apart. The covered plate is now placed in position under the tube, the length of spark used and the distance between the tube and the plate being carefully noted. A thick piece of sheet lead, having a straight edge, is now laid over the plate so as to protect all but the first marked off division. This is exposed to the action of the X rays for a definite time (say ten seconds), when the current is cut off. The edge of the lead is now moved to the second line, and again a similar exposure is given. The process is repeated until the whole of the plate has been exposed, when the last exposed division will have had an exposure of ten seconds, whilst the twelfth (counting the shortest exposed division as one) will have received 120 seconds' exposure. The plate should now be developed with a standard ferrous-oxalate developer, until the least exposed portion has obtained some density. An examination of the negative will show which portion has received the correct exposure, granting, of course, that the rays from the tube were sufficiently powerful to produce the best result in the length of time occupied by the full exposure. If it is thought that none of the exposures have been sufficiently long, the experiment may be repeated on a second plate (the whole plate being given an exposure equal to the most lengthy one of the first plate, before the first division receives its extra ten seconds). I have found this method exceedingly useful in helping me to form a judgment of the working of my apparatus, and if the standard ferrous-oxalate developer be used, together with a timed development, we have at hand a ready means of determining the relative rapidities of various brands of plates.

The necessary length of exposure to a great extent depends upon the rapidity of the plate used, the action of the X rays being exactly identical with that of light.

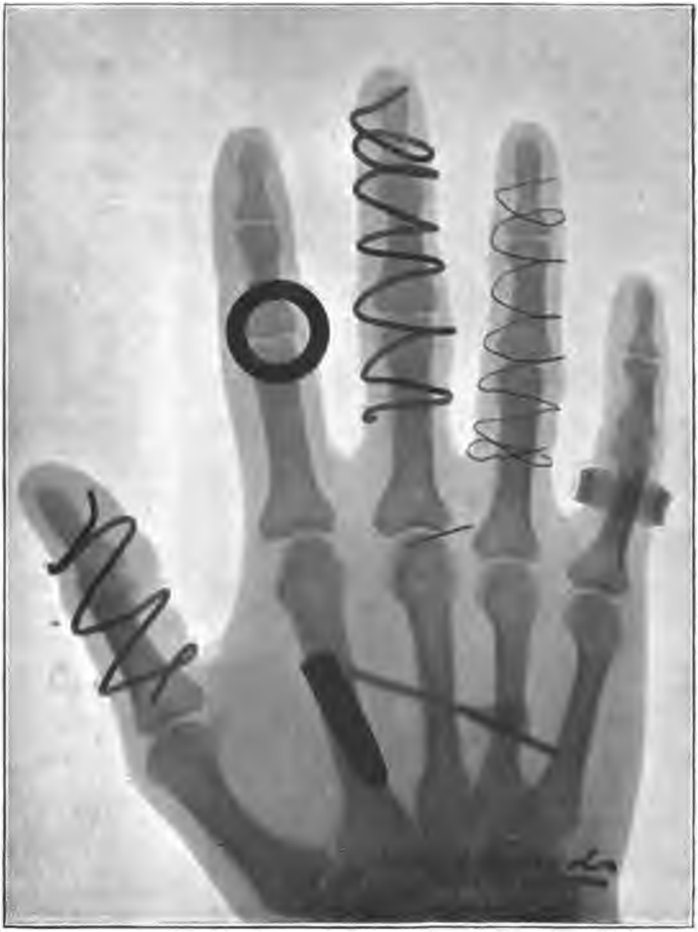
Experience has taught me that very rapid plates are not necessary, and that slow ones yield much better results, the chief characteristics of a good plate being thickness of film and quantity of silver.

For the radiographing of most objects, time is not a matter of the greatest importance, and as a long exposure upon a slow plate yields the best result, it should always be adopted, unless there be a pressing reason for getting results quickly

Development.—In the matter of developers there is little to be said, with the exception that one that acts slowly and gives a good depth of image is preferable to the new quick-acting ones, which cause the image to flash up directly they are poured over the plate. Pyro-soda (Ilford's formula) and the hydroquinone developer of Thomas have in my hands yielded the best results.

Printing.—Prints from radiographic negatives may, of course, be made upon any paper, but for medical purposes I prefer P.O.P., as it is most easily managed to show even the most minute details.

Prints may be taken directly upon bromide paper, the exposure being about four times that required for the slowest plate.



For description see overleaf.

A useful method of obtaining a print in the shortest possible time is by using Dr. Hill-Norris's special positive plates. As these are collodion plates, they can be dried before the fire without the slightest risk. Full instructions for using these will be found upon the boxes containing them.

The thumb is encircled with a piece of thick tin wire.

Under the index finger is placed a brass ring.

The middle finger is encircled with copper wire.

The ring finger with cotton-covered copper wire.

An indiarubber band is placed on the little finger.

A portion of needle is pushed under the thick skin at the base of the middle finger.

A bullet and triangular piece of glass were placed under the palm, and a piece of tin wire upon the top of the hand.

ADDITIONS AND CORRECTIONS WHILE PRINTING.

153a. Any of the following alkalies may be either substituted for, or mixed with, the soda carbonate in any formula, in proportion to the work done by each, which is here shown:

Relative work done by fixed alkalies in developers.

Soda hydrate (caustic soda)	10·0	
Soda carbonate crystallised (washing soda)	2·8	
Soda carbonate anhydrous...	7·6	
Potassium carbonate	5·0	nearly.
Potassium carbonate anhydrous	6·0	,,
Potassium hydrate (caustic potash)	7·1	

It will be seen from the above table that when *used in equal weights*, the carbonate of soda will only do work to the value of 2·8, whilst the carbonate of potash will do work equal to 5·0, or nearly double, hence the two ounces of carbonate of soda in formula No. 3 may be replaced by one ounce of carbonate of potash.

The calculation of the equivalents of alkalies is easily made by multiplying the quantity in the formula by the number representing the working value of the alkali prescribed, and dividing the product by the working value of the alkali which it is desired to substitute.

165a. *Ortol.*—This is a new developer of the aniline group. The formula recommended by the maker—M. Hauff—is as follows:

No. 12a.—Ortol developer.

A.		B.	
Ortol	150 grains.	Sodium carbonate ...	3½ ounces.
Potassium metabisulphite	75 ,,	Sodium sulphite	2½ ,,
Water	20 ounces.	Water	20 ,,

For use.—Take equal parts of A and B, and add half a grain of bromide to each ounce of solution. Bromide has a more powerful effect in slowing ortol than it has with metol.

The ortol developer *keeps well,* it does not soil the fingers, and has but little tendency to fog or stain the negative. It is excellent for bromide paper when diluted with an equal quantity of water.

169a. *Formalin and acetone.*—Until quite recently it has always been considered that (with the exception, perhaps, of amidol) an alkali of some kind was essential to the efficient action of any developer. M. Lumière has, however, discovered that either formalin or acetone—which are in no sense alkaline—can be substituted for the alkalies hitherto used. Formalin is to be preferred to acetone, notably by reason of its less unpleasant smell. Formalin does not seem to be so suitable for use with pyro as with the aniline developers. Lumière gives the following formula:

No. 15a.—Quinol and formalin developer.

Quinol	7 grains.
Sodium sulphite...	70 ,,
Formalin	8 minims.
Water	1 ounce.

This developer gives considerable density.

224a. *Ammonium persulphate reducer.*—This reducer has recently been introduced by Messrs. Lumière. The solution is made of the strength of twenty grains per ounce of water. When the desired reduction has been effected, the negative is placed for some minutes in a ten per cent. solution of sodium sulphite, which stops the action of the reducer, which would otherwise continue while washing. Finally, wash thoroughly. "It is claimed that the persulphate attacks the denser parts of the negative in preference to the fine details, and, hence, can be used for the treatment of negatives that have been under-exposed, and subsequently developed so as to bring out as much detail as possible; in other words, unlike some of the more familiar reducers, the persulphate lessens the contrasts in the negative. It is noteworthy that the persulphate is an efficient hypo eliminator, as well as a reducer."

238a. *Velox paper.*—This is of American origin, and is said to be a slow chloro-bromide paper. In use it is treated like ordinary bromide, but requires considerably longer exposure than the quick bromide papers generally used for contact printing.

Ordinary "Velox" requires an exposure of from one to seven seconds to a diffused north light, and from one to three minutes at the distance of a few inches from a naked paraffin lamp. *Special* Velox is about three times as fast as the ordinary kind, but it develops more slowly—see para. 264a.

240a. *Gum-bichromate process.*—This is the revival of a process originated by Poitevin in 1855, and practically worked by Pouncy in England a few years later. Like carbon paper, the process depends on the action of light on a pigmented paper sensitised with bichromate of potash, the chief differences between the two processes being that in the carbon process the colloid used is gelatine, and the image has to be developed from the back, whilst in the gum-bichromate process the colloid used is gum-arabic, and the image develops from the face.

Our space will not admit of giving minute details, which may be obtained from a little book by W. J. Warren (Iliffe, Sons & Sturmey Ltd.) Suffice it to say that suitable paper is first sensitised with a solution of bichromate of potash, dried, and then coated with any desired pigment, mixed with a solution of gum-arabic, in the proportion of two ounces of gum to five ounces of water.

As the picture hardly prints out at all, an actinometer is necessary, Wynne's being generally recommended.

The picture is developed by laying the print face downwards in water for half an hour, or until the picture is fully out.

264a. *Velox developer.*—The following formula is recommended by the makers:

Metol-quinol developer for Velox paper.

Metol	7 grains.
Quinol...	30 "
Sodium sulphite	½ ounce.
Sodium carbonate crystals	400 grains.
Water...	10 ounces

Add ten drops of a ten per cent. solution of potass. bromide.

The above developer will not keep, but it could be rendered much more stable by making it up in two solutions, the metol, quinol, sulphite, and half the water in one, and the sodium carbonate and half the water in the other, and mixing in equal parts when required for use.

The same developer may, of course, be used for several prints, but this must not be overdone if strong blacks are required. The makers recommend an acid fixing bath. Formula No. 16 may be used.

It is claimed for this paper that it can be used with the maximum of light. My experiments with this paper have been decidedly favourable.

CORRIGENDA.

Para. 142, page 51.—Delete (see fig. 7) and (see fig. 8).

Para. 162.—Amend the formula as follows:

No. 10.—Metol developer.

A.		B.	
Metol	150 grains	Sodium carbonate cryst...	1¾ ounces.
Water	20 ounces.	Potassium bromide ...	8 grains.
When dissolved, add		Water	10 ounces.
Sodium sulphite ...	2½ ounces.		

The metol must be dissolved before the sulphite is added.

For use.—Take one part of A, one part of B, and one part of water, and for plates inclined to fog add up to twenty drops of a ten per cent. solution of potassium bromide; for under-exposure dilute the developer. To meet possible errors in exposure do not add the whole of solution B in the first instance, but begin with a smaller quantity.

Same para.—Delete last eleven lines on page 62, and first thirteen on page 63.

Para. 228, line 4, for 376 read 393.

Para. 281, formula, for water 1 ounce read water 10 ounces.

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LLMEYER STIGMATIC LENSES. PATENT.

:RIES I., A PORTRAIT LENS, f/4.

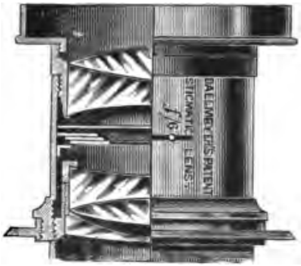
FULL PARTICULARS ON APPLICATION.

; II., THE NEW UNIVERSAL LENS, f/6.

eed.

power.

m from
m,
lat field.

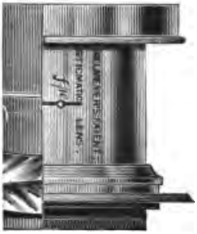


Can be made to serve
as
FOUR different lenses.

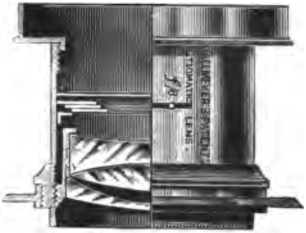
Complete lens, as used for rapid and wide-angle work.

able for every class of photography, from portraiture to wide-angle work.

es are particularly suited for hand camera work, covering the plate *to the ture* (f/6). At a smaller aperture (f/16) they will cover a plate two sizes acing a very *wide angle*. Besides this, each combination may be used nt combination having a focus of about one and a half times, and the back entire lens. Thus, a "*Stigmatic*" *does the work of four ordinary lenses.*



ation used as single lens.



Back combination used as single lens.

vered at ture, f/6.	Largest plate covered at f/16.	Diameter of lens.	Eq. Focus.	PRICE, with Iris diaphragms.
2	4¼ x 3¼	·55in.	3·25in.	£4 0 0
2½	5 x 4	·65	4·0	4 5 0
3¼	6½ x 4¾	·8	4·5	4 15 0
3¼	8 x 5	·9	5·3	5 15 0
4	8½ x 6½	1·1	6·4	6 15 0
4¾	10 x 8	1·3	7·6	8 2 6
5	12 x 10	1·6	9	10 10 0
6½	15 x 12	1·9	10·7	13 10 0
8	15 x 15	2·2	12 7	18 10 0
10	18 x 16	2·6	15·1	24 10 0
12	22 x 20	3·1	18	31 10 0

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